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Vol. 32. 505 PEARL STREET, NEW YORK. No. 11.

Index to Advertisers and Classified Index Following Reading Matter.

NOW ONE

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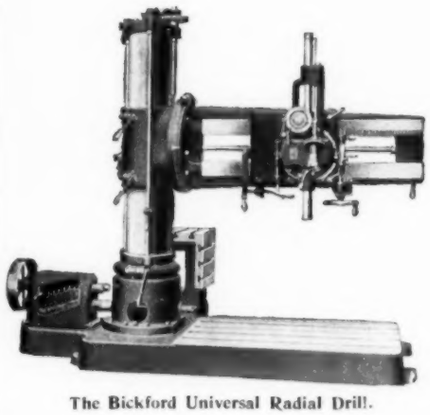

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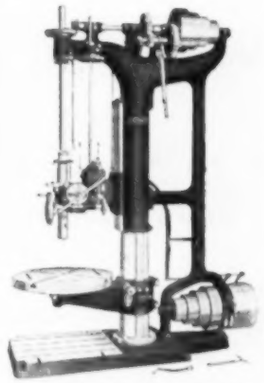

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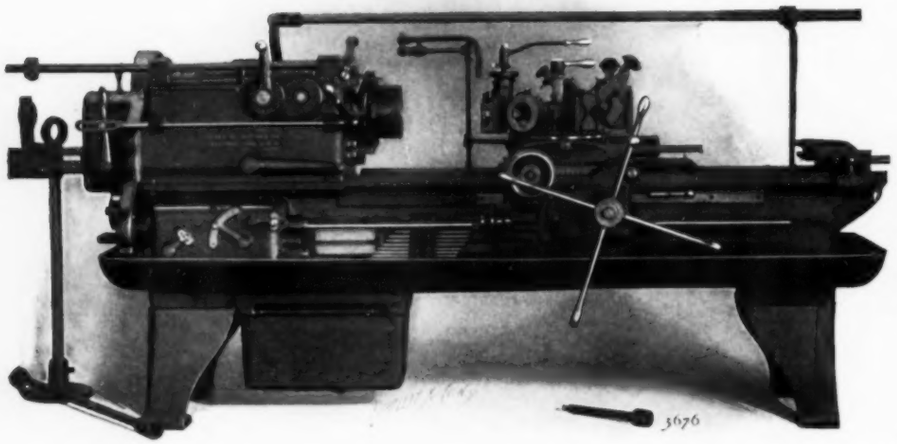

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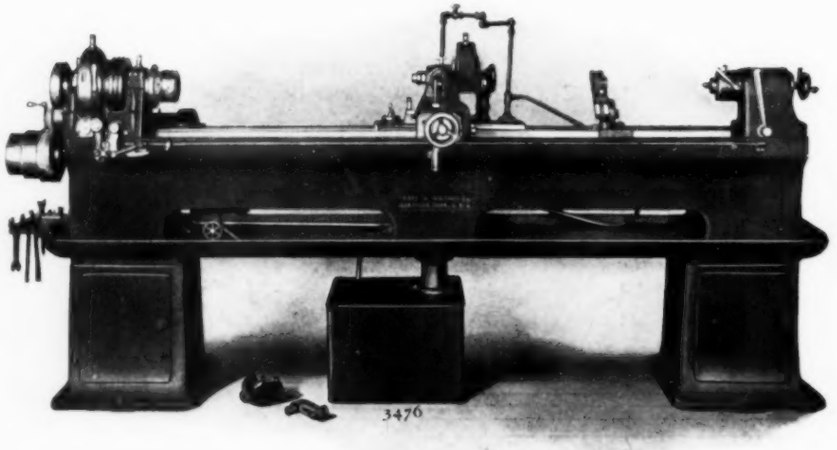

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Flanging, Punching and Welding

Shop Equipment Including the Special Spacing Table and Portable Magnetic Drill. Examples of Work Done and Methods of Doing It

BY CLAUDE AIKEN

Flanging is a subject to which, except in a desultory fashion, very little attention has usually been paid. Manufacturers in general accept it as a real or partial necessity along certain lines, to be avoided if possible; and the expensive machinery needed for first-class work often prevents them from seeing its advantages. Notwithstanding this fact, however, the use of flanging is steadily increasing, due to the greater strength of construction required by higher pressures and temperatures, and, as in the case of steel castings, manufacturers are turning mainly to outside plants having special equipment, for all work of this character, an interesting example of which follows:

The complete machinery for all kinds of regular and irregular flanging, dishing, hot pressing, etc., of plate steel, has been installed in one of the large plants in Chicago, where, in addition to the special plates required a large quantity of custom work is regularly turned out, ranging from the hot-pressing of shapes from 6 to 104 inches in size, to cold-flanging up to any dimensions required. For sectional flanging there is also no limit. Many of the large manufacturing and metal-supply houses of Chicago and vicinity have been regularly bringing their plates to this plant for treatment, and while this work was started merely as an adjunct to the company's regular lines of machinery building, it has gradually become an important specialty.

Shops and Equipment

A visit to this section of the works has considerable interest. The work consists of cutting to size, drilling, punching, beveling, welding, etc. The boiler shop is 396 feet 6 inches by 129 feet 2 inches, which equals 51,215 square feet, and the flange shop is 187 feet 2 inches by 30 feet 2 inches, making 7330 square feet.

Standing prominent among the other machines are a 160-ton hydraulic press for sectional flanging, either hot or cold, which was built by W. H. Wood, Media, Penn., and a 4-column Niles-Bement press, of 550 tons pressure capacity, for flanging plates of unusual size. For use

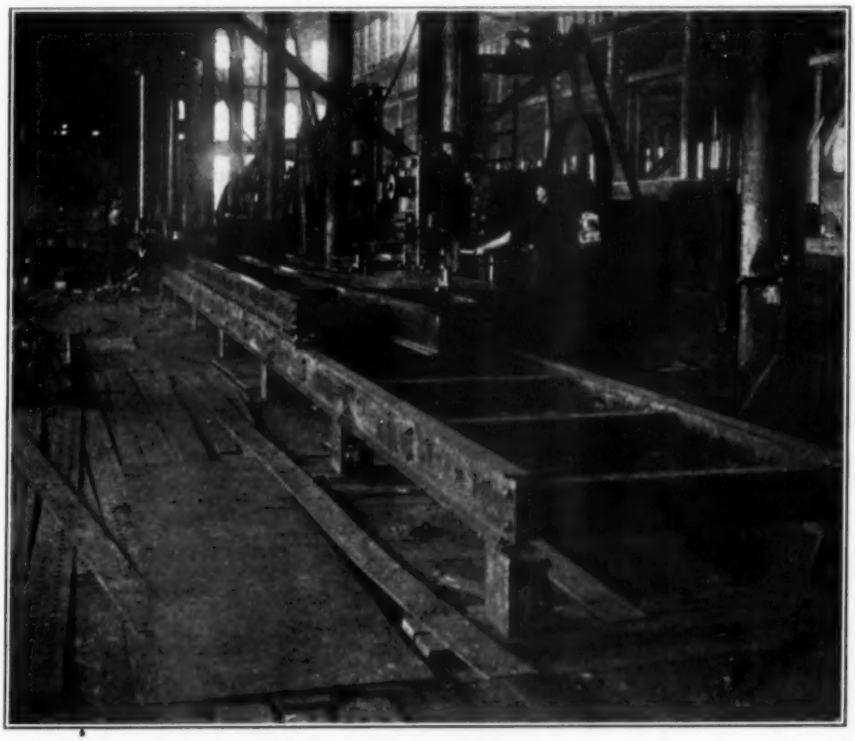


FIG. 2. SPACING TABLE AT WORK ON A PLATE

FIG. 1. A SECTION OF THE MARINE BENDING FLOOR

with these presses there are dies in great variety. These have been collecting, for some years past, as flanging in varied shapes was required to be done, and they now represent, either single or in combination, practically all shapes that can be conceived of as in any way adapted to industrial service.

For heating the plates and other structural shapes there are two oil-fired furnaces of special construction. One of these has a 12-foot hearth.

Pressure at 1500 pounds to the square inch is maintained from a central pumping plant located in the boiler shop. An accumulator also forms part of the system, and six pneumatic hoists are installed here.

Bending Floor and Rolls

Particularly noteworthy is the marine bending floor, a section of which is shown

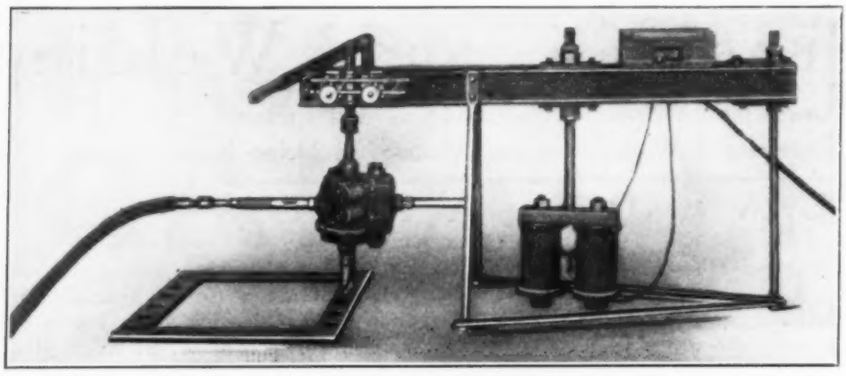


FIG. 4. MAGNETIC OLD MAN

in Fig. 1. This is made of heavy cast-iron plates so constructed as to give alternate spaces and solid sections, very similar in appearance to a checker board. The spaces or pockets are so designed that practically any irregular templet or series of templets can be followed in outline by placing pins in the pockets. When these pins have been properly arranged, the work to be formed is brought red hot from the furnaces and bent so as to fit against the pins, where it is held in place by clamps, and allowed to cool; or bending forms may be bolted to the floor and work brought up against them. Angle irons, structural shapes and flat bars can be formed here to particular advantage.

In the boiler shop, immediately adjoining the flanging department, is the largest set of bending rolls in the West. They are capable of handling sheets of any size, up to and including 22 feet in length and 1 inch thick. The top roll is 27 inches in diameter and weighs 40,000 pounds. This set of rolls is operated by direct-current motors, and is under the complete control of the operator at all times. A separate motor is used for elevating the top roll. Power from the motor shafts is transmitted to the machine through spur gearing. These rolls were manufactured by Hilles & Jones and are supplemented by smaller sets of the same company's design, from 10 feet down to 6 feet, for light sheet-metal work.

Spacing Table

There has also been installed here a spacing table, which is the invention of the superintendent. This is one of the largest tables in the country and the only one of its kind. It possesses several features novel to this class of machinery, one of which is that a single operator is enabled to space or handle the heaviest plate that can be put upon the table. Plates weighing as much as 7000 pounds have been punched here, and the one man assigned to the work has not, in any instance, had difficulty in moving such plates for the various spacings required.

In Fig. 2 is shown the spacing table as it is being used to punch three notches, 2x6 inches on each side of a plate. Twelve binding bolt holes that are 9/16x5/8 inch are also punched in the sheet; one on each side of the six notches. These plates are set, notched and punched on both sides of the sheet at the rate of 130 per day.

With this table the usual saw-tooth

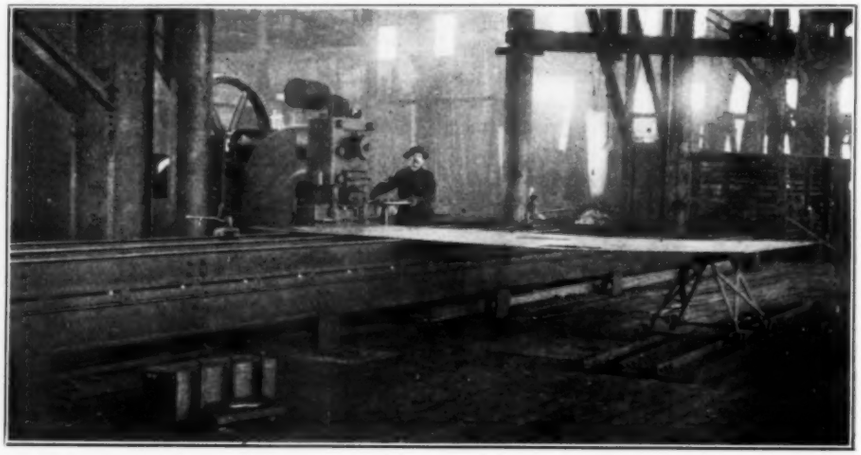


FIG. 3. SPACING TABLE WITH AUXILIARY CARRIAGE OR OUTRIGGER

FIG. 5. FLANGED HEADS FOR WATER TANKS, ALSO FURNACES AND PRESSES

rack, with its wear and other faults, is done away with, and in its place is used a steel templet. This, together with its locking pin, will accurately space any layout within the scope of the punch to which the table is attached. The templets are quickly and cheaply made, and but a few moments' time is required to attach any templet to the machine. The design of the table is such that the only limit to the size of the plate to be punched is the room available for operating in. For example, sheets 30 feet in length and 3/4 inch thick, that are punched for 7/8-inch rivets in one, two or four rows, can be punched as readily as smaller sizes.

The machine is constructed almost entirely of structural shapes, the only cast iron used being the spreaders and stools for carrying the beams or rails. This style of construction gives not only a very light table, but also one of considerable flexibility, which will yield to the work clamped upon it, without detriment to the apparatus and without impairing the accuracy of the work to be performed.

In connection with this table there is being used a Geo. Whiting No. 11 structural punch, and, with the various attachments used, not only plates, but also structural shapes and butt straps can be punched. There is also an auxiliary carriage, or outrigger, shown in Fig. 3, which is used when punching across the ends of long plates, thus enabling the ends as well as the sides of plates of any dimensions to be moved easily and accurately punched.

Some of the Work Done

On this table butt straps ¾ inch thick, 10 inches wide, and 22 feet long, with four rows of ⅞-inch rivets, can be punched in ten minutes at one setting. Sheets ⅝ inch in thickness, 8 feet wide and 22 feet long, with a double row of ⅞-inch rivets all around, two settings being required for each end, have been easily punched in 1½ hours, whereas, under the old spot-punching system, these plates required over eleven hours each.

Another interesting example given by the superintendent, is the recent punching in from ten to twelve minutes each, of several hundred tank plates. They were 3/16 inch thick, 4 feet wide and 10 feet long, with a single row of holes on all four edges for ½-inch rivets, and these were spaced 1½ inches between centers. As an experiment, these plates were piled twenty to thirty high, and a bar of the same diameter as the rivets could be passed through any set of holes without interference. This shows the extreme accuracy of the machine. Two men are, of course, required to put the plates on and off the table, but after the plates are set one man does all of the spacing. The ends and sides of a sheet having different spacing can be punched by the use of double templets.

Machinery Used

Other machines included in the boiler shop, which are of interest merely as showing the completeness of the equipment for every character of work coming within the scope of this department, are a 24-foot planer for straightening the edges of plates either on a square or bevel; a rotary shear, by means of which beveling circles, special shapes, etc., can be done in the minimum amount of time, and leave a clean, even edge on plates up to ¾ of an inch in thickness. This gives them the proper bevel for calking; a line of punches of various sizes, a 6-foot clamp of the company's own make, for plate bending and hand flanging; a 4-inch angle-iron shear; a multi-spindle drill, a 24-inch splitting shear for light sheet metal; a rotary splitter for shearing plates up to ¼ inch in thickness; two riveting bulls of 75 and 30 tons pressure, with the necessary hydraulic hoists; a pneumatic riveter constructed especially for such work as water-jacket flange riveting; a 10-foot brake for bending sheet steel into shapes like hoppers, cones, etc.; a power-driven stake or horn riveter for water pipes, smoke stacks, etc.; a structural punch for I-beams and channels up to 24 inches, also used in connection with the spacing table described above; a magnetic holder-on or "old man" for holding air drills for drilling and countersinking; an oxy-acetylene welding apparatus and other standard equipment found in an uptodate boiler shop.

This department is served by two 30-ton cranes, and all of the machinery is driven directly, or from short lines of shafting by the company's own direct-current motors.

FIG. 6. OIL-TANK CAR HEADS AND STEAM-DRUM HEADS

FIG. 7. SET OF WATER-JACKET PLATES FOR COPPER-SMELTING FURNACE

Magnetic "Old Man"

Among the most interesting of the apparatus mentioned above is the magnetic "old man," which is shown in Fig. 4. This is also an invention of the superintendent, and the device is made of two channel bars, held together with suitable plates, and provided with three round iron legs.

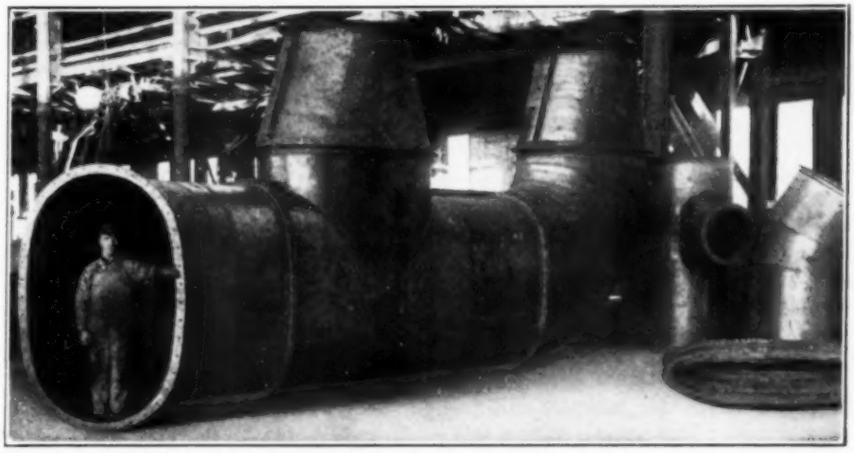


FIG. 8. SHEET-STEEL BLAST PIPE WITH WELDED ANGLE-IRON FLANGES

There is a suitable carrier inside the channel bars that is mounted on wheels, which permits of an easy movement of the drill back and forth. An air drill is suspended on a spindle in the center of this carriage, and it may be readily raised or lowered by means of the lever. The frame swivels freely around the upright from the magnets, thus allowing work to be done in a complete circle, whose radius would be equal to the distance from the center of magnets to the end of the channel bars. The legs are arranged so as not to interfere with the free movement of the drill when the magnets are engaged. The holding power of magnets is readily arranged in their winding to suit the work to be done.

This machine is very convenient for countersinking and other work where lever feed will answer the purpose, but by substituting a regular screw feed for the lever, much heavier drilling can be done.

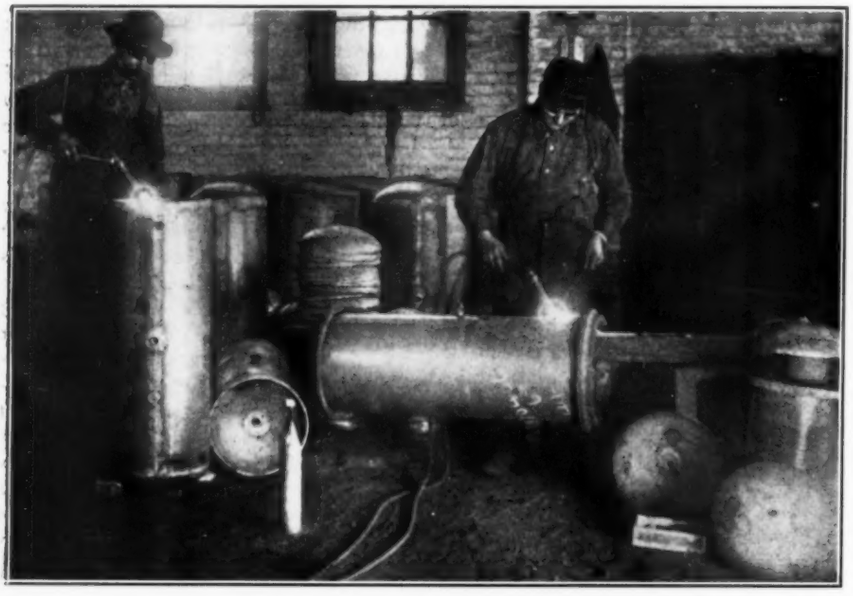


FIG. 9. WELDING HEADS ON AIR-BRAKE RESERVOIRS

Flanging

It is, of course, unnecessary to dwell upon the fact that cast-iron flanges have been superseded for all important service by forged and rolled steel. To turn out good work of this kind, however, requires special facilities, and it can only be handled on a satisfactory basis where these have been provided.

Among the flanging done may be mentioned work on heads for hot-water tanks. These have the flanges turned while hot, and one lot that has just been finished is shown in Fig. 5. In the background are shown the furnaces and presses that are used in heating and flanging them.

The flanged work, shown in Fig. 6, comprises heads for oil-tank cars and steam drums. This work is flanged while hot and when finished there is no appearance of buckling in the flanges.

One of the most interesting jobs of flanging done in the shop is the irregular-shaped pieces, shown in Fig. 7. These are a set of water-jacket plates for a copper-smelting furnace, and it will be noticed that some of the flanges are very wide, and that the corners are turned nearly square. There would be altogether too much stock at these corners to bend and press them into shape, and, therefore, welding was resorted to as an aid to the flanging operation. The autogenous welding process proved of great benefit for this job, as with it the corners could be welded in much cheaper than the work could be done in any other way. The shape of the corner that is welded in is best shown at *A*, the white lines on each side of the corner that take the shape of a V, showing where the corner was welded to the side flanges.

Welding

Another job in which the autogenous process was of great use is the sheet-steel blast pipe, shown in Fig. 8. This pipe required for its construction a number of angle irons of special shapes. To make these angle irons two pieces were cut of sheet metal and they were welded together at the corner, as the angles were easier and cheaper made in this way than by the old method.

The oxy-acetylene process is the one that is used in this plant, and the superintendent says that he is finding new uses for it every day. In Fig. 9 it is shown at work welding heads in air-brake reservoirs. This process is used for welding all angle irons, as well as for a large amount of work of a similar nature and also for a large quantity of plate work.

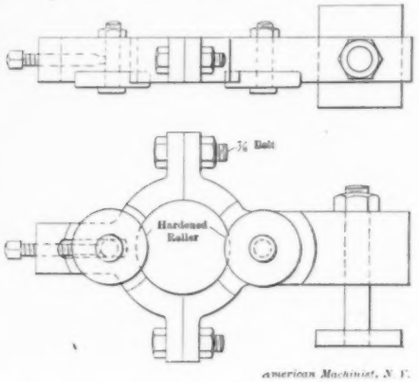
Many other shapes and forms are flanged, pressed, punched, riveted and welded in this department, but as they are too numerous to mention, only a few of those that were being worked upon could be used as examples of the class of work that is being done.

Roller Tool for Piston Rods

By Stanley Edwards

The accompanying blueprint shows a piston-rod roller now being successfully used in different shops along the line of the Union Pacific railroad. It is the invention of Thomas Roberts, the present machine foreman at the company's shop at Cheyenne, Wyoming. By its use the necessity of filing a finish upon the piston rod is entirely eliminated.

Before placing it in regular commission it was tried upon three different grades of work, one being a shaft turned with a very coarse feed, one with a very ragged finish, and the third having heavy chatter marks. After running the roller over these shafts they were left with a very smooth, straight finish without any perceptible change in the length of the rod or shaft and without leaving any marks of identification upon them. Metallic packing is used exclusively upon these rods, which necessitates a smooth finish, and as the surface left by the roller is far superior to a file finish, its introduction seems to have solved a problem in time saving and the production of superior work.



ROLLER FINISHING TOOL FOR PISTON RODS

The roller is used with feeds varying from 1/32 to ⅛ inch. Rods that are but slightly worn are trued up by the roller alone and without taking a cut with a tool. The method of application is as follows: The end carrying the bolts and clamps is secured to the slide rest. The roller on this section is fed up to the work by the cross-feed screw. The other section is then clamped to this one by means of bolts, as shown, and this roller is forced against the work by the adjusting screw, which presses against the stud carrying the roller, this stud working in a slot about 2 inches long. The parallel feed is then applied and the operation begins, the rolling being done in oil. I believe there is no patent on this device, and it is through the kindness and consent of Mr. Roberts that this description is furnished.

Machine Accounting in Machine-Tool Building

Use of the Tabulating Machine by the Bullard Machine Tool Company, Saving Time, Money and Giving Detailed Distribution

EDITORIAL CORRESPONDENCE

In a recent issue, on page 249, we presented an article entitled "Machine-shop Cost Accounting by Machinery." It discussed the first application of the tabulating machine to machine-shop cost accounting. This article deals with the first installation and use of the tabulating machine and its accessories in the cost-accounting department of a machine-tool building firm, namely, the Bullard Machine Tool Company, of Bridgeport, Conn. Although there has been only three months' use at this writing the results are as striking and successful as in the case of the installation described in the preceding article. Yet the application is different, for it has been worked out to meet the needs of a machine-tool building firm producing a single line of product.

The machinery outfit for this mechanical cost accounting consists of one automatic four-counter tabulating machine, one automatic sorting machine, a gang punch and a key punch made by the Tabulating Machine Company, Washington, D. C.

As the original data for any machine-shop system of accounting are obtained from the time-keeping records a time-card envelop form is shown by Fig. 1, and three representative time cards by Figs. 2 to 4, inclusive, as the starting point for tracing out the steps in the use of the tabulating machine. Each workman is given a time card envelop when he enters the factory in the morning. In the left-hand upper corner is a ruled section stamped 7 a.m., if the workman comes in at that time, or prior to that time. In the upper right hand corner is a similar ruled space, to be checked when entering the factory at or before 1 p.m. In case a workman enters late the envelop is checked with a blue pencil, with the exact time. Thus this envelop serves the purpose of checking the workman's time and fulfils the function usually executed by a time-clock slip or card.

Upon this envelop the man writes his number and name in spaces prepared therefor. It should be recognized that this envelop is in no sense a time card, for a time card of the forms indicated by Figs. 2 to 4 inclusive is made out for each and every job that the workman does. These three specimen cards are presented to show one day's work of workman 399 and correspond with the time-card envelop of Fig. 1. Each morning the time cards for the preceding day are slipped into the corresponding envelop, passed through the hands of the department foreman, and are forwarded by him to the cost-accounting office. A reference to Figs. 1 to 4, inclusive, will show a letter *H* in the lower right-hand corner. This letter is cut by a small steel punch in the possession of the department foreman and serves as an indication that the foreman has verified the correctness of the envelop and its cards.

Organization of the Departments

The factory is arranged on what is usually styled the "one-shop plan;" that is, the organization is composed of individual departments each one of which in general has machine tools of a given kind and performs a certain machine-shop operation. As, for illustration, the drills are grouped in a general drilling department, lathes in a general turning department, and the like. There are 20 of these departments indicated by numbers, beginning with No. 20. Thus they can be grouped into two classes, one class having numbers, of which the figure in the tens place is 2, and the other numbers of which the figure in the tens place is 3. This division is made use of in connection with some of the sorting-machine operations and will be referred to later.

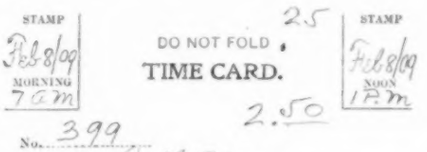


FIG. 1. FORM OF TIME CARD ENVELOP

Distribution Classification

We have mentioned that this firm builds but a single line of machinery; that is, boring mills and vertical turret lathes and accessories. For this reason the number of distribution classifications is much smaller than will be found in a machine-shop building a varied line of machines. Production orders are distributed under four classifications, lettered *A*, *B*, *C* and *D*. Beyond this are other letters running through to *O*, each one of which cares for a general series of expense items. Again, for each letter classification there is a corresponding series of shop-order numbers. For production orders these numbers are indicative of a given job. For expense items which are permanent in character, that is, for items which repeat themselves successively week by week perpetual order numbers are assigned within the proper number limits for the corresponding letter classification. Should a condition arise whereby an unusual item of expense needs to be cared for in any one of the expense classifications, a special order number may be issued in its proper series to cover that particular work, and to be closed after the work is completed. These, broadly, are the classifications to which all labor items must be distributed.

Making Up the Pay-roll—Punching the Machine Cards

The time cards are received by the cost-accounting office in bunches from the individual machine-shop departments. The first operation is to put on the man's hourly rate and the amount of the day's earnings, as indicated by the number of hours. Referring to Fig. 1, it will be noticed that the number of hours are 10, the rate 25 cents, and the day's earning $2.50.

The time cards are then removed from the envelops and are priced according to the number of hours indicated upon them and the man's rate. The cards for each department are then totaled on a comptometer and the corresponding envelops are also totaled. These totals must balance before the time cards are passed to the clerk who punches the corresponding tabulating machine card.

The envelops are now taken to the proper cutting machine which trims the edges so that the front of the envelop may be separated from the back and the fronts only are selected and filed until the end of the week, when the six days' fronts are assorted to the individual man number and the pay-roll is made up therefrom. The pay-roll total must balance against the total distribution as determined from the card records.

After a balance is established between each department group of time cards and the corresponding group of time-card envelops the time cards are taken by a clerk and tabulating-machine cards punched therefrom. Figs. 5, 6 and 7 show three machine cards properly punched to correspond with the time cards of Figs. 2, 3 and 4. There is a distinction between these three time cards which it is well to point out at this time. The card of Fig. 2 is for productive day work; the card of Fig. 3 is for productive piece work; while the card of Fig. 4 is for nonproductive work. Day-work cards are printed on a buff-colored stock, while all piece-work cards are printed on a blue stock.

After the cards are punched by departments, the machine cards are totaled to see that they agree with the total amount upon the envelops, and after this balance has been obtained the cards are gang punched by departments for the year, month, day and week, it being possible to punch about 15 cards at a time.

The fields of the machine cards are arranged to tabulate the following data: The month and year (see the upper left-hand corner), the day of the month, department number, man number, job number, piece number and symbol, division number (refer to the small numbered sections in the lower central part of Fig. 2, and note that motor drive (10) is checked on this card and that the number 10 is punched in this corresponding field on the card of Fig. 5), operation, contract number if piece work, number of hours, amount of direct labor, machine number (note that the hundredths of the machine number are indicated by the figures 1, 2 and 3 in the extreme right-hand field of the card). At the top of this right-hand field are three groups of letters, which are R e, N p, and P r. These are symbols for replacement, nonproductive and productive, respectively, referring, of course, to the character of the labor performed. In the lower part of this right-hand field are four symbols, which are R H, O H, P A and P S. These indicate regular hours, over-time hours, piece-work allowance and piece-work settlement, respectively.

The connection between the indicated punched holes on these specimen cards and the data on the corresponding time cards is readily traced.

Labor Distribution

We have now traced the punching of the tabulating machine cards from the time cards. All of the time cards for a given day, in number from 500 to 600, are first sorted into productive and nonproductive classes. This is done by sorting to the holes in the extreme upper right-hand corner. We have previously stated that for each distribution classification, as indicated by a letter, there is a corresponding series of order numbers. Thus all production orders have a number lower than 10,000; similarly, all nonproductive or expense orders have numbers 10,000 or greater. After the sorting into two groups, one representing a productive and the other a nonproductive class, the accuracy of the punching is tested by a needle. If all of the nonproductive cards are properly punched, a needle will pass through all the cards of the group in the hole indicating 1 in the ten-thousandth column of the field entitled "Job Number." Any card through which the needle fails to pass is improperly punched as regards the connection between the order number and the classification nonproductive. Similarly, a needle should pass through all of the productive cards in the hole indicating zero in the ten-thousandths column under the field heading "Job Number." This is a rapid mechanical check of the accuracy of the punching expressing the relationship between order number and class.

The cards for each classification are then sorted to the numbers 2 and 3 in the tens column of the second field from the left-hand end entitled "Department." This gives four groups for each day's machine cards, and into these four groups all of the cards are filed until the end of each week.

At the beginning of each week—say late Monday afternoon—all of the cards for the week preceding are ready to be sorted for the distribution. One sorting for each

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1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 1909

MAN'S NAME Bill Dea | NUMBER 399 | CONTRACT NO.

JOB NO. 950 | PIECE NO. a228 | NO. PIECES | NO. MACHS. | START

NAME OF PIECE | HOURS 4

1 HEADS	4 TABLES	7 CROSS RLS & SAD	10 MOTOR DRIVE	13 TURRETS	16 LEAD SCREW	19 COUNTERS
2 FEEDS	5 SIDE HEAD	8 POWER TRAVERS	11 DRILL HEAD	14 CARRIAGE	17 TAIL STOCK	20 CENTER REST
3 BEDS	6 TOP RAILS	9 SPEED BOX	12 CHANGE GEARS	15 APRONS	18 TAPER ATTACH	21 SCREW CUTTING

AMOUNT 100

Hand Turret	7	Centering	16	Buffing	32
Cutting Off	10	Cleaning	23		
Chucking	14	Painting	24		

O. K. H FOREMAN THE B. M. T. CO.

FIG. 2

Dept. 22 | FOR DEPT. | REPLACE | OVERHOURS | MACH. NO.

Jan. Feb. March April May June July Aug. Sept. Oct. Nov. Dec. 1908
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 1909

MAN'S NAME Bill Dea | NUMBER 399 | CONTRACT NO. 9026

JOB NO. 890 | PIECE NO. 615B | NO. PIECES | NO. MACHS. | START

NAME OF PIECE Binding shoes | HOURS 5

1 HEADS	4 TABLES	7 CROSS RLS & SAD	10 MOTOR DRIVE	13 TURRETS	16 LEAD SCREW	19 COUNTERS
2 FEEDS	5 SIDE HEAD	8 POWER TRAVERS	11 DRILL HEAD	14 CARRIAGE	17 TAIL STOCK	20 CENTER REST
3 BEDS	6 TOP RAILS	9 SPEED BOX	12 CHANGE GEARS	15 APRONS	18 TAPER ATTACH	21 SCREW CUTTING

AMOUNT 125

Milling	3	Milling Keyways	45		
Cutter Grinding	5				
Milling Gears	44				

O. K. H FOREMAN THE B. M. T. CO.

FIG. 3

Dept. 21 | FOR DEPT. | REPLACE | OVERHOURS | MACH. NO.

Jan. Feb. March April May June July Aug. Sept. Oct. Nov. Dec. 1908
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 1909

MAN'S NAME Bill Dea | NUMBER 399 | CONTRACT NO.

JOB NO. 11012 | PIECE NO. | NO. PIECES | NO. MACHS. | START

NAME OF PIECE | HOURS 1

1 HEADS	4 TABLES	7 CROSS RLS & SAD	10 MOTOR DRIVE	13 TURRETS	16 LEAD SCREW	19 COUNTERS
2 FEEDS	5 SIDE HEAD	8 POWER TRAVERS	11 DRILL HEAD	14 CARRIAGE	17 TAIL STOCK	20 CENTER REST
3 BEDS	6 TOP RAILS	9 SPEED BOX	12 CHANGE GEARS	15 APRONS	18 TAPER ATTACH	21 SCREW CUTTING

AMOUNT .25

Hand Turret	7	Centering	16	Buffing	32
Cutting Off	10	Cleaning	23		
Chucking	14	Painting	24		

O. K. H FOREMAN THE B. M. T. CO.

FIG. 4

FORMS OF SPECIMEN TIME CARDS

group arranges the cards into shop departments. This is the final sorting. In passing it is interesting to note that this rate of sorting is 240 cards per minute.

After this sorting the productive and nonproductive items are tabulated by hours and amounts to determine the expenditure on each item in each department. The productive items are then assorted into job numbers and the hours and amounts distributed under these numbers by departments, there being a total of about 75 different jobs.

The nonproductive items are distributed at the end of the month into expense classifications and according to department if desired.

Piece-work

There is still another series of labor items that remains to be traced through. These items are piece-work bonuses. Fig. 8 shows a specimen contract card properly filled out to correspond with the piece-work time card of Fig. 3. It is unnecessary to go into the details of the piece-work system as in force, except to state that a workman's wages are paid weekly according to his shop rating, and that piece-work bonuses are handled in a separate account and are paid after the completion of the job. The card indicated by Fig. 8 shows a piece-work bonus of 25c. Fig. 9 shows a corresponding machine card properly punched. Cards of this kind as they are punched are filed with the machine cards regularly punched from the time cards, and the data which they carry are distributed in the regular way.

Advantages of the System

On page 253 we pointed out three major advantages of tabulating-machine cost accounting as defined by the results obtained at the Pennsylvania Steel Company. These three advantages hold in connection with the work as now being carried out by the Bullard Machine Tool Company. They are: A reduced expense in connection with cost accounting; a lessened time necessary to prepare the monthly statement; and distribution analyses in great detail and of great elasticity and accuracy.

The monthly statements as they are now being compiled at the Bullard plant comprise some 122 items. This work of distribution is done in about 4 hours, and the amount of detail is much greater than by the former accounting method; in fact, it would have been impractical to have obtained the amount of detail which is now available with the facilities which were formerly in use.

The actual cost of the labor and expense distribution will not exceed ½ of one per cent. of the total amount thus distributed, and, of course, a much larger amount could be distributed with no greater expense, provided it was not made up of a larger number of individual items.

In regard to accuracy, the tabulating machine has a field that is all its own. Should we take a given sum, say $10,000, and distribute it into 200 items, the labor of totaling and making those 200 items balance with the original sum is a serious mental tax on a cost-accounting clerk. Errors are apt to show, and are oftentimes of a nature almost to defy tracing. On the other hand, given a certain group of tabulating-machine cards, whose items amount to, say $10,000, it is a very easy matter to separate these into 200 groups, total the items in these groups, and then have the grand total of all the group totals check with the original amount. This is one of the important advantages of the tabulating machine in the application that we are considering.

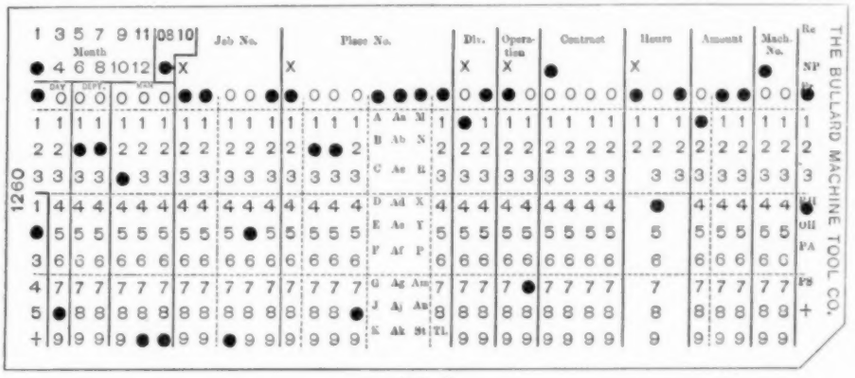


FIG. 5

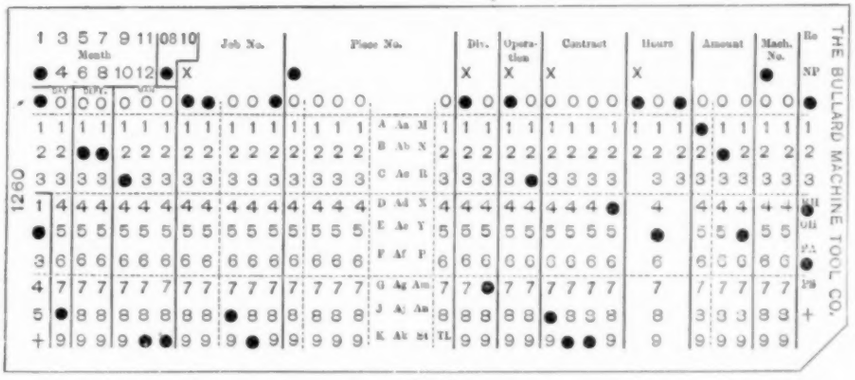
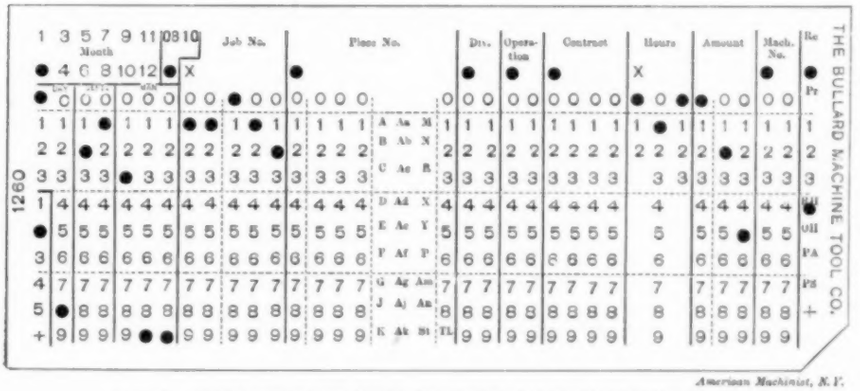


FIG. 6



American Machinist, N. Y.

FIG. 7. SPECIMEN TABULATING MACHINE CARDS CORRESPONDING WITH TIME CARDS OF FIGS. 2, 3 AND 4

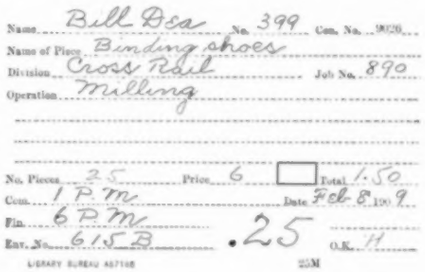

Name Bill Bsa No. 399 Com. No. 9020
Name of Piece Binding shoes
Division Cross Rail Job No. 890
Operation Milling
No. Pieces 25 Price 6 Total 1.50
Com. 1 P.M.
Fin. 6 P.M. Date Feb 8 1909
Emp. No. 615 B .25 O.K.

FIG. 8. PIECEWORK CARD CORRESPONDING WITH TIME CARD OF FIG. 3

Additional Uses

In addition to the uses that we have outlined for the machine cards, they are also used to determine the percentage of piece-work hours to day-work hours. This merely involves sorting the cards to the letter symbols in the lower right-hand field. Formerly this work was done by a clerk who required 18 hours per week in order to work out this percentage. The machine time is 24 minutes for the chief clerk and a boy assistant, or a total of

48 minutes for the two persons, which is directly comparable with the 18 hours mentioned above. As stated earlier in this article, at the time our material was gathered the machines had been in use only about three months. Certain applications were then contemplated which had not been put into effect. Among these is the ascertaining of the amount of defective work by using the upper part of the right-hand field in which the symbol *R E* indicates replacement or the replacing of work which has been spoiled. By sorting to that field for any given period of time desired it will be possible to determine the number of hours and direct labor cost of replacing spoiled parts.

We have shown how machine cards are punched to cover piece-work bonuses. By sorting a given group of cards to this classification it will be possible to find out the gross amount of piece-work bonuses for any period desired.

Another promising field of use is to determine the number of productive hours per department. This might very naturally be an item which would be gathered and tabulated week by week in order to check and study the manufacturing conditions in each department. With an analysis of this kind at the command of a shop superintendent it would be possible to determine whether or not a machine-tool equipment was adequate or inadequate for a given condition of business. These facts are often very desirable, for it is easy for a department foreman to make a vigorous request for more machine tools on the plea that he is getting behind in his work, when as a matter of fact the number of productive hours worked in his department may be far less than the possible number if all of his machines are kept running to their capacity.

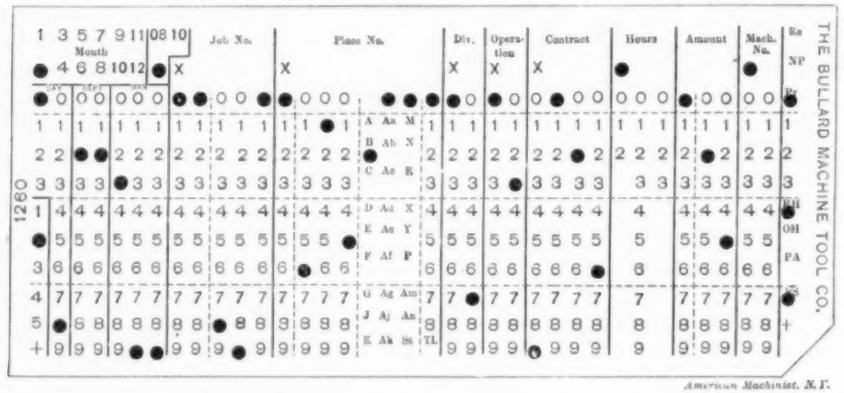


FIG. 3. TABULATING MACHINE CARD CORRESPONDING WITH FIG. 8

A Perpetual Inventory

The company also proposes to keep a perpetual inventory by using the tabulating machine. Two of the counters are totaling counters, while the other two are simple adding counters; that is, amounts for different groups will be added on two of the counters, and the total amounts of these various groups will be added together to form a grand total on the other two counters. In using the machine for this purpose it is proposed to prepare cards for all of the material received and shipped by the plant. With these cards in hand it will then be a simple and rapid process to run them through the tabulating machine weekly, monthly, or at the end of any period desired, and thus obtain debit and credit totals that will give a perpetual inventory.

Drawing an Ellipse with Compasses

By F. L. S.

In Kent's Handbook, geometrical problem No. 45, third method, a process is given for drawing an ellipse with compasses, using eight centers. The method, as regards the radii for the side and end curves is simple, and gives radii which, for ordinary ellipses, are approximately correct. The method of getting the radius for the curve to connect these two is, however, not only complicated, but it gives a radius which is much too short for narrow ellipses.

I submit a method for getting this third radius which is not only much simpler, but which gives a radius that works well on either wide or narrow ellipses. The whole process of drawing is as follows, reference being had to the accompanying illustrations.

Lay out the long diameter *A B* and the short diameter *C D*, Fig. 1, crossing each other centrally at *F*. Construct the parallelogram *A E C F*, and draw the diagonal *A C*. From *E* draw a line at right angles to *A C*, crossing the long diameter at *H* and meeting the short diameter, extended, if necessary, at *G*; *H* is the center, and *A H* the radius for forming the end of the ellipse; *G* is the center, and *C G* is the radius for forming the side. To this point the process is the same as that given by Kent.

To get the third radius lay off a base line *A B*, Fig. 2, of any convenient length, and divide it into five equal parts by the points 1, 2, 3 and 4. At one end of this line erect the perpendicular *A C*, equal to the radius *A H*, and at the other end erect the perpendicular *B D*, equal to the radius *C G*. Connect the upper ends of these perpendiculars by the line *C D*. From point 2 erect the perpendicular 2 *E*. The length 2 *E* will be the desired third radius. With the compasses set to this radius find, by trial, a center *I*, Fig. 1, from which a curve can be struck which will be just tangent to the curves struck from the centers *H* and *G*. Lines drawn from *I* through *H* and from *G* through *I* will determine the meeting points of the different curves. From other centers similarly located the remainder of the ellipse is formed.

For narrow ellipses the radius *A H* with which the ends are formed should be lengthened somewhat as follows: When the breadth of the ellipse is one-half of its length lengthen *A H* one-eighth; if the breadth of the ellipse is one-third of its length, make *A H* one-quarter longer; if the breadth is one quarter of the length, make *A H* one-half longer.

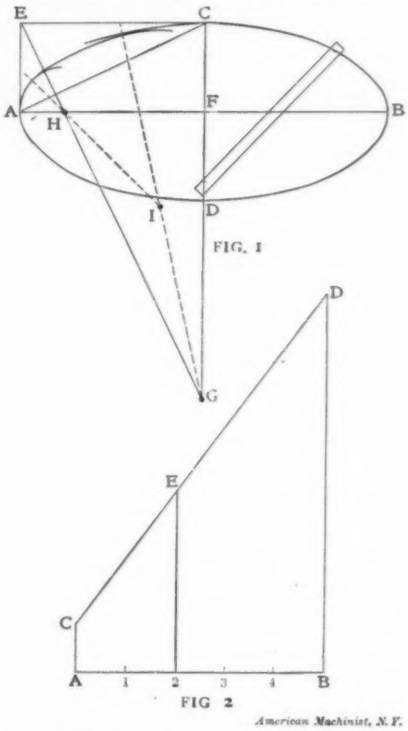


FIG. 1

FIG 2

DIAGRAMS ILLUSTRATING THE DRAWING OF ELLIPSES WITH THE COMPASSES

With this modification of the end radius the method gives curves which blend well together so as to satisfy the eye, and gives an outline which, when tested by the trammel method of locating points in the outline of an ellipse, as shown at the right, Fig. 1, is found to conform quite closely to the correct figure.

It may be objected to this method that the center *I* has to be found by trial. But the method given by Kent, while pretending to give the center, does not exactly do so, it being necessary to relocate it by trial.

A Propeller Planing Machine

By W. F. Rice

The growing demand for propellers correctly machined to the form of a true screw for large steamships has brought out a number of interesting devices for doing this work. A German machine, a product of the Vulcan Iron Works, is perhaps one of the largest yet designed, especially for this purpose; it has capacity for machining propellers up to 23 feet in diameter and of any desired pitch. It is a massive machine weighing about 40 tons. This machine planes the blades in a circular direction, the arm carrying the cutter swings on a center in line with the propeller axis.

The common method of machining propellers has been to place the propeller upon a revolving table on a planer, with its axis perpendicular to the planer table and plane radially from the tip of the blade toward the hub. A feeding mechanism connecting the revolving table with the planer tool slide revolves the propeller on its axis and feeds the cutting tool downward simultaneously with each stroke of the planer. This method seems only a makeshift, ordinarily tying up a planer nearly as large as the diameter of the propeller, for a considerable period, due to the slow cutting speeds of most large planers. This method, however, has served the purpose where no great amount of this class of work was necessary.

Another machine designed and in use at the Fore River yard, has proved very successful and combines the use of a small planer and a revolving table located on a separate foundation at the end of the planer. The propeller is placed on the revolving table with its axis perpendicular to the planer table. A feeding mechanism connects the revolving table with a cutter bar carried on a post which is bolted to the planer table. At every stroke of the planer the cutter bar feeds downward and the propeller revolves simultaneously.

These last two methods are alike in principle, both using screw gearing to obtain the proper ratios of feed between the cutting tool and the revolving table. In the first method, however, the propeller moves and the cutting tool is stationary, while in the latter this condition is just the reverse. The last method is much to be preferred as it allows the use of a small planer with a much higher cutting speed.

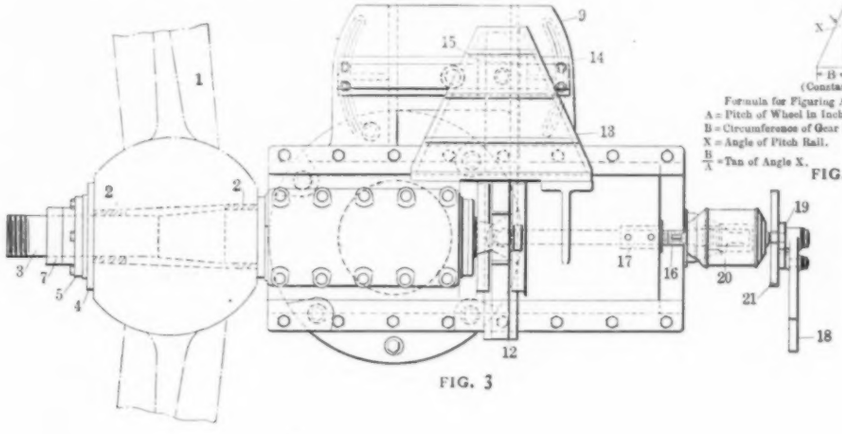


FIG. 3

Formula for Figuring Angle of Pitch Rail.
A = Pitch of Wheel in Inches.
B = Circumference of Gear Pitch Circle in Inches.
X = Angle of Pitch Rail.
$\frac{B}{A}$ = Tan of Angle X.

FIG. 5

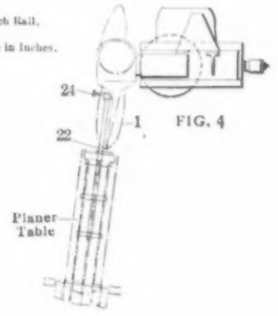


FIG. 4

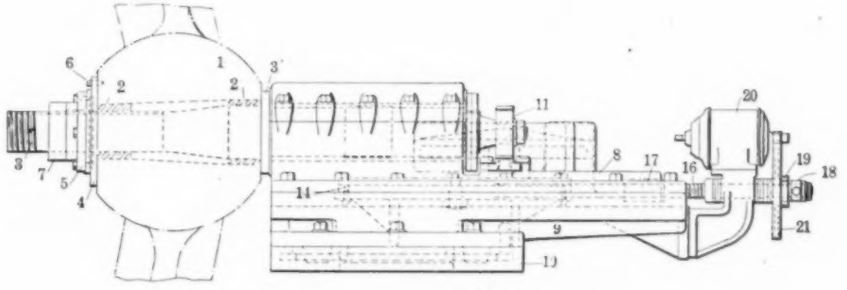


FIG. 1

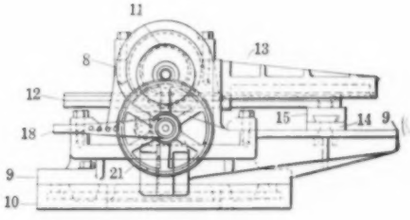


FIG. 2

SCREW PROPELLER GENERATING MACHINE

A Recent Design

The machine herein described is quite different from any of the above types. No screw gears are necessary for generating the different pitches. The machine is simple and it is believed to be a very practical method for machining propeller blades. The machine is termed "A True Screw Generating Device," to be used in combination with an ordinary small size metal planer or shaper. The description follows:

In the accompanying drawings, Fig. 1 is a side elevation, Fig. 2 an end elevation, Fig. 3 a plan. The propeller 1 is fitted with bushings 2-2, which in turn fit a spindle 3. Upon the spindle 3 is fitted loosely the collar 4 and the keyed collar 5. The collar 4 is doweled to propeller by the pin 6. The loose collar 4 contains a circular T-slot in which are bolts connecting it with keyed collar 5. The propeller and collars are all forced by the nut 7 against the collar 3′ of the spindle. The object of these tight and loose collars is to provide means for adjusting the different blades in position for planing. By loosening the bolts engaging the circular T-slot, the propeller may be moved on the shaft at will, or by tightening them, making the propeller fast to the shaft. Spindle 3 is journaled in the slide 8. Slide 8 is gibbed to the base 9, which rests on the subbase 10.

The subbase 10 is provided with a circular T-slot which allows the whole device to be swiveled thereon. If the propeller blade has a rake aft, as is sometimes the case, this provides means of setting it in line with the action of the cutter bar, which, as will be later described, is fastened to the planer table.

To the spindle 3 is fastened the gear 11, which meshes with the rack 12 sliding in ways in the base 9. An outer guide 13 for the rack is provided, which is also fastened to the base 9. The base 9 is provided with a shelf-like support 9′, which carries the pitch rail 14, which swivels on the base

9, and may be fastened at any angle which, as will be described, determines the pitch of the screw to be generated. The block 15 slides on the pitch rail 14, and is connected by a pin journaled in the rack 12. The feed to the slide 8 is driven by the screw 16 engaging the nut 17 and fastened to the slide 8. This screw is operated by the ratchet lever 18 engaging the ratchet 19, said lever being moved by suitable connection to the planer table, thus feeding the slide 8 forward at every stroke of the planer. A reversible motor 20 engaging the gear 21 provides a rapid movement of the slide 8, either forward or backward.

The generating machine should be located at the end of the planer, as shown in Fig. 4. To the planer table is fastened the cutter bar 22, which carries the cutter head 24. The cutting tool should be on a radial line with the center of the spindle 3.

It is obvious that to cut a true screw with the cutting tool working in the same plane, the propeller must rotate while advancing; the angle of the pitch rail 14 determining the pitch of the propeller. The rotating movement is obtained by advancing the slide 8, which moves the block 15 along the pitch rail 14, which in turn moves the rack 12 engaging the gear 11 and revolving the spindle 3.

Adjusting the machine for planing a given pitch only requires the setting of the pitch rail to its corresponding angle (see Fig. 5), then at every stroke of the planer the slide 8 is advanced turning the propeller in the proper ratio. It will be noted that either right- or left-hand screws may be generated by simply moving the pitch rail 14 to the right or left of the zero mark. This will revolve the propeller in its proper direction without changing the direction of the movement of slide 8.

The machine is primarily designed to machine the propeller blade by working the cutting tool in a radial line, but by the use of the motor 20 the blade can be rotated across the cutting tool, which enables the machining to be done in a circular direction, advancing the cutter bar at each rotation a sufficient amount to give the desired feed.

It will be noted that the generating machine is placed at the forward end of the planer. This gives the planer tool a draw cut which is very desirable as it allows the cut to start at a solid portion of the blade, the cut increasing gradually as it approaches the end of the blade which is quite thin. This obviates all shock and springing of the blade, which would occur if the operation was reversed.

It is necessary, of course, when using the draw cut, to provide a groove for a starting place for the tool. This groove is cut by rotating the propeller (by use of the motor) across the cutting tool in the same manner as if the blade was to be planed in a circular direction.

A Homemade Pneumatic Elevator

By Philip Bellows

The half-tones shown herewith were secured in a large shop in Greater New York and illustrate a little, homemade elevator; at once so simple, effective and ingenious as to call for attention on our part. The concern which I speak of has a tool room which has failed to grow in size as the size of the shops has increased; consequently with the passing of time its capacity has become overtaxed. It was, therefore, decided to open another room overhead for the purpose of taking care of this overtaxed condition. It was then found that someone had to run up and down stairs very often with a resulting loss of time. It was just here that an ingenious mechanic came in with the result that the stairs could be abolished and a further saving of valuable space on the ground floor secured. The power necessary to operate the contrivance is secured from the main air line of the shop; 90 pounds is the working pressure.

Fig. 1 shows the cage; Fig. 2 shows the overhead construction at the top of the shaft; Fig. 3 shows the cylinder. From these three views it will be seen that the whole mechanism is most compact and represents the ideal of simplicity.

FIG. 1. CAGE OF SMALL HOME-MADE PNEUMATIC ELEVATOR

Referring to Fig. 1, it will be seen that an odd corner has been utilized, and far less space taken up than would have been necessary with anything more bulky than a plain ladder. The upright guides are two galvanized pipes about 1½-inch in size. The platform is about 2 feet square and of hardwood, say, 1 inch thick and well cleated underneath. The upright bars are of cold-rolled steel about

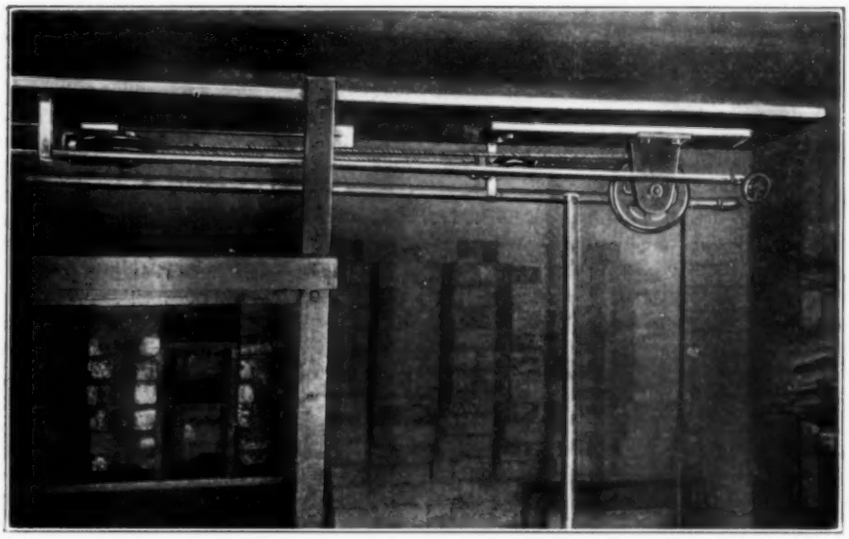


FIG. 2. OVERHEAD CONSTRUCTION—TOP OF SHAFT OF PNEUMATIC ELEVATOR

⅞-inch and to them is bolted the cross bar taking the shackle of the rope. The rope is 7/16-inch steel wire cable and runs at the top over a cast-iron sheave set in two angle plates which in turn are bolted to the ceiling of the upper room. A square hole with about ⅜ inch all-round clearance was sawed in the corner of the latter to allow the elevator to pass through.

After passing over the sheave just referred to, the rope passes horizontally parallel with the ceiling and the wall to another sheave which is a fellow of the first, but attached to the end of the piston rod, as shown in Fig. 4; it then returns and is attached to an eyebolt attached to a bracket, as shown in Fig. 2. The piston rod is a piece of cold-rolled steel 1 inch in diameter. The piston, as seen in Fig. 5, is a cast-iron block turned 1/64 smaller than the interior of the cylinder. The latter is a piece of drawn-brass tube, 3½ inches in diameter by 4 inches outside, so smooth and true that it was not deemed necessary to bore it. The cup leather shown at the forward end of the piston works admirably. The cylinder ends are blocks of cast iron attached to small sections of wrought-iron angles ⅜x6x3 inches, which in turn are bolted to the ceiling. In action the pet cock, shown at the rear of cylinder, Figs. 3 and 5, is regulated so that, as the elevator is rising, enough air shall be retained in the cylinder to cushion the piston and prevent sudden shock.

To operate the device, after taking your stand on the little platform you pull one side of the continuous cord shown in Fig. 1, and this action opens a three-way valve admitting air from the main to the cylinder. When descending you operate the cord the reverse way and this action allows the air which is pent up in the cylinder to return along the feed pipe and find an exit through one passage of the three-way valve into the open air; at the same time, of course, cutting off the communication between the main and cylinder. The hole in the plug of the valve by which the exhaust takes place is about 5/32 inch in diameter so that the descent is not too sudden.

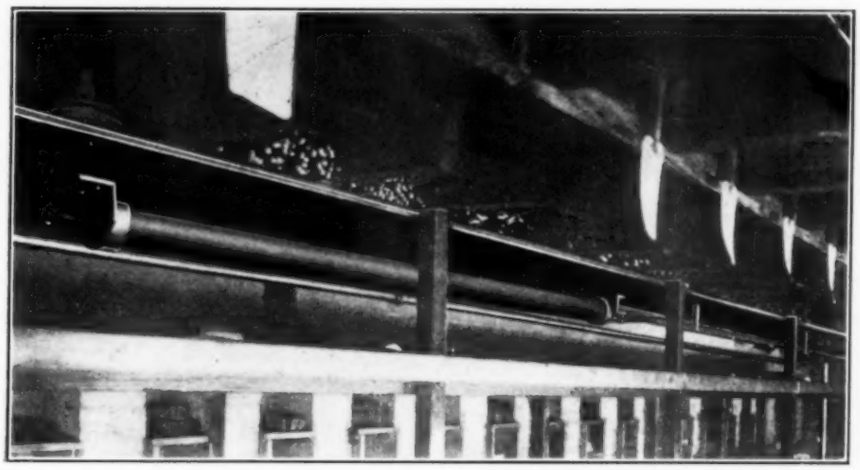


FIG. 3. CYLINDER OF PNEUMATIC ELEVATOR

The sensation of a ride on this simple, yet useful, little elevator is worthy of note. After taking one's stand in the cage the cord is pulled and you expect sudden

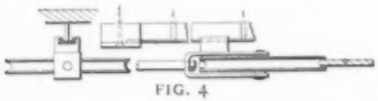


FIG. 4

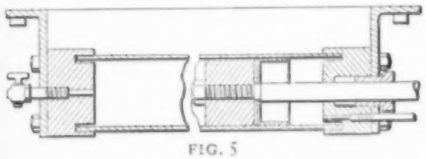


FIG. 5

DETAILS OF SHEAVES AND CYLINDER OF PNEUMATIC ELEVATOR

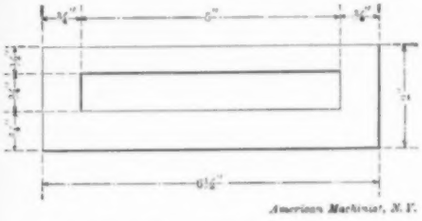
death, but you become alarmed when you find nothing has happened and you stand in fear of, you know not what, for a space of about two seconds. You have just begun to think of giving the trigger a second tug when up you go with an airy bound and your face is on a level with the floor above, a distance of some 14 feet; just about this point the cushion at the back of the cylinder is coming into action and you arrive at your destination with scarcely a jar. The delay at the start is to be accounted for, no doubt, by the time required to fill the pipe and part of the cylinder.

Device to Be Used in Lettering Drawings

By T. J. S. Kishpaugh

Every draftsman appreciates the necessity of having the tracing cloth or paper perfectly clean and free from wrinkles while lettering, and especially in lettering the titles. If the tracing cloth is flat and free from wrinkles it not only adds to the smoothness of the work but increases the transparency of the cloth.

I have for some time past been using the device, a cut of which appears herewith for obtaining this end. This device consists of a piece of celluloid, or of thin wood, cut as shown, and placed on the drawing with the slot over the part of the drawing to be lettered; a slight pressure



DEVICES FOR LETTERING TRACINGS

exerted upon the edges will make the part of the tracing directly underneath very smooth and free from wrinkles, thus insuring rapid and accurate tracing of the lettering on the original drawing.

A Thread Cutting Job

By X. Y. Z.

Recently I found a nut to crack that may have been a source of annoyance to others, and if so, it may be as well to tell of it for the general good. A stone quarry four or five miles away sent in for a man to come out "right away" to overhaul some steam drills. Five hours was sufficient to get the drills going, and just as I was about to start back to the shop the quarry's "engineer" brought out the "nut." A length of 2-inch steel tubing, 12 feet long, was required to be threaded and put in; he had no die; wanted to know if I had. I hadn't, but thought I could fix him up somehow. As the shop was after business, I got into my overalls again and went to work. Upon investigation I found the man was right; he had no die. The nearest resemblance I could find to a thread-cutting tool was a large, battered, dull square of steel, that many years ago had been a die, and it was also an inch too large.

Later, when I had need of one, I found out also that the only pipe wrench was entirely too small. I quit looking and asking for tools and went to work. There were plenty of short pieces of 2-inch tubing, from 2 inches up to 2 or 3 feet in length. I chose a piece about 6 inches in length and threaded on one end. Then I looked up a plain union for it. Then I cut a small sapling nearby, and cutting off a piece about a foot long, tapered it lightly at both ends, and whittled it as nearly round as possible, leaving it a good drive fit. Then I drove it about half its length into the long length, and put the short length on over the other tapered end of the plug, and placing a piece of board on the end so as not to damage the threads, drove it down hard and fast. Now taking this joined tube out on a little platform at the rear of the engine room, I got a piece of timber 4x6, cut off four lengths about 2 feet each. Taking two of these lengths and cutting V's in the narrow side (large enough to bind the 2-inch pipe tightly), I spiked one down to the floor good and firm (in spite of the protests of the "engineer"), V-side up. Then the long length of the tubing was laid in the V and the other block put over it, V down, and spiked securely to the lower block. The other two blocks had V's cut in the middle, on the narrow side also, but a little larger, to receive the union. Six feet from the other blocks one was spiked down, the union was oiled and screwed on the end of the short length of pipe a turn or two; the union was then laid in the V, and at each end of the union nails were driven, getting as much purchase as possible, to prevent end movement of the union. Then a small handful of sand was thrown in on the union to help my wooden clamps to keep it from turning; the top V-block was put on and spiked down firm. I found an old, worn-out, flat file and broke about ½ inch off the end and ground it into a threading tool on what I firmly believe to be the very worst grindstone I ever saw in my whole life, driven by the good old "Armstrong motor" of our forefathers. Now after a few trials I found a single block that would bring the cutting point up to the center (the file, of course, set edgewise); this block, like the others, was spiked down. Squaring from the long tube, a pencil line was struck across the block, and verified by trying the relation of the cutting point to the tube, with a center gage. To this line a block was nailed, or rather two, as one of the right thickness could not be found; this block was even with the hight of the file; against this block the file tool was set, and on the other side a block was nailed firmly against it. Behind the tool a block was nailed, with a scrap of iron between it and the file, and on top of all was nailed a board. This arrangement, of course, was fixed at the end of the tube where the short piece was joined on by the plug, and where the thread was to start. The file was set in for a light cut. All things being secure, it remained to find a means of turning the tube. A stout cord and a stick about 3 feet long solved this. The length of the long tube ran out over the platform 5 feet or so. One end of the cord was tied to the end of the stick and the cord was then wrapped around the tube and tied to the stick again, after the manner of using a chain wrench. The tube was now screwed down into the union, and in passing the cutting point a thread was cut on the long pipe. When it was run down far enough it was unscrewed, and the file was tapped forward a little and a scrap of sheet iron put between the scrap of iron and the wooden block behind the file. Four cuts were taken, and the job was all right. Then I had the "engineer" sign up my time and I started for home. The job required two hours and a half. After the first cut each cut was stopped 1/16 inch short.

A Recording Ammeter and a Special Milling Machine

Among the interesting contrivances in the works of the Ferracute Machine Company, Bridgeton, New Jersey, is a special recording ammeter worthy of mention. All of the machine tools are motor driven and it being desirable to record the amount of current consumed in a given

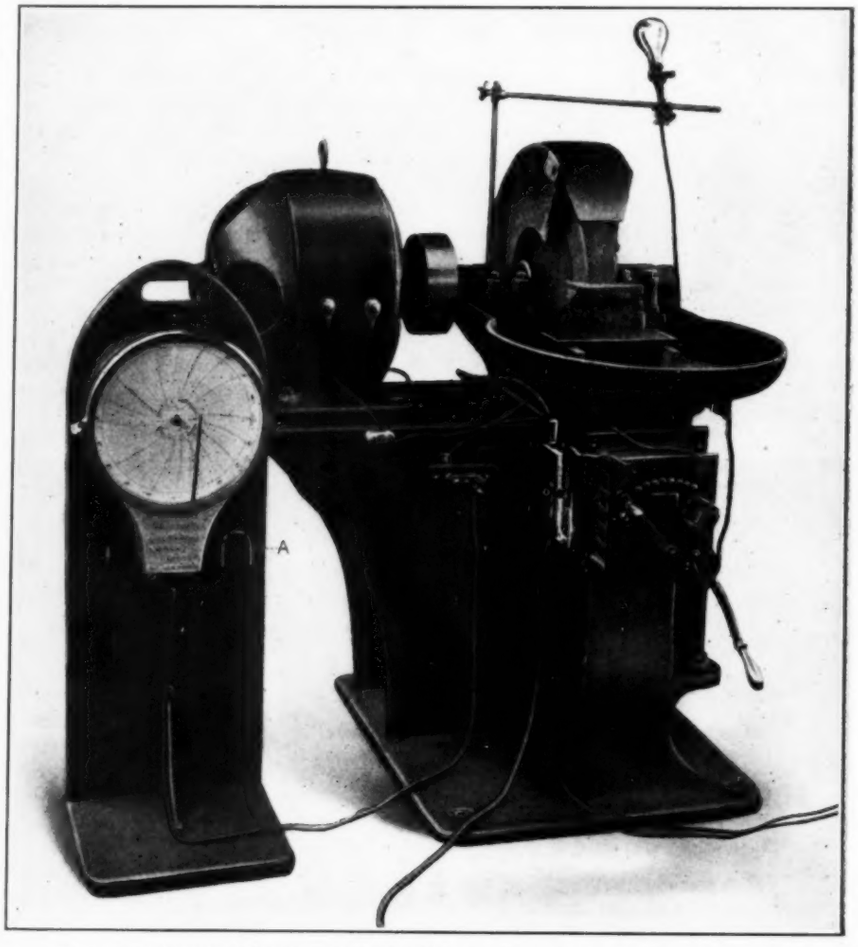


FIG. 1. RECORDING AMMETER FOR FINDING POWER CONSUMED BY MACHINE TOOLS

time by the individual machines, Oberlin Smith, the president of the company, had the instrument shown in the accompanying illustration constructed for the purpose. It consists of a standard Bristol ampere meter with a special recording disk indicating consumption of current in horsepower instead of watts as in the ordinary meter, the clockwork being adjusted so as to make a revolution of the disk every five minutes. The circuit in each machine contains a horseshoe plug *A* which is exactly the same size and shape as the plug connected with the ammeter, it requiring only an instant to withdraw one plug and replace it with the other.

The circular chart or disk contains radial lines on which the horsepower is indicated, the meter recording up to 15 horsepower. The circumference of the disk is graduated in 5-second spaces, the disk making a revolution every five minutes. When the ammeter is in operation, the pen at the extremity of the recording arm makes a line on the revolving disk, the amount of horsepower consumed at any given time being shown by the position of the line on the disk.

The contrivance has several advantages, not the least of which is being able to read at a glance of the chart what the machine is doing in horsepowers, and enabling the superintendent to ascertain if the machine is working up to its capacity or possibly beyond it. It also serves as a telltale that cannot be contradicted as the ink line left by the recording pen on the chart is evidence not easily questioned.

A Milling Machine for Special Work

The machine illustrated herewith is a special tool known in the shops of the Ferracute Machine Company, Bridgeton, N. J., as a clutch miller, also designed by Mr. Smith, of the company, to shape the surface or shoulder *a* of the clutch lever shown on the floor. A clutch lever is an essential part of the pin clutch found on nearly every press made by this company. It is a steel casting, the shoulder *a* containing a warped surface, its function being to throw out the clutch at the end of the stroke of press. The cylindrical pin which bears against the shoulder is called the clutch beam.

As might be imagined, it is not an easy job to dress the shoulder accurately by hammer, chisel and file. Mr. Smith conceived the idea of having this work done by a special milling machine, evolved from a pedestal lathe which was so badly damaged when the destructive fire occurred at the Ferracute works as to be useless as a lathe.

The engraving shows a swinging bed pivoted to brackets bolted to the frame and housings for the guide-roller similarly attached. A revolving table, containing on its periphery a guide corresponding to the clutch-lever shoulder, is centered on the swinging bed. An adjustable weight is attached to the rear of the bed serving to keep the guide up against the roller throughout the milling operation. A vertical sleeve containing a handwheel at its upper end, the lower end having gear teeth which engage with teeth cut in the table, gives circular motion to the table. The milling cutter in the spindle of the machine is made the same diameter as the clutch beam. Holes are drilled in table to locate the several jigs, the machine being adapted for milling a number of sizes of clutch levers, the motions on the machine conforming with those incident to the clutch parts on the press.

To do the work, it is only necessary to place the clutch lever in its jig and bolt the jig to the table. The machine is started up and a cheap boy does work in a few minutes that was formerly done in a much longer time and less satisfactorily by a skilled machinist.

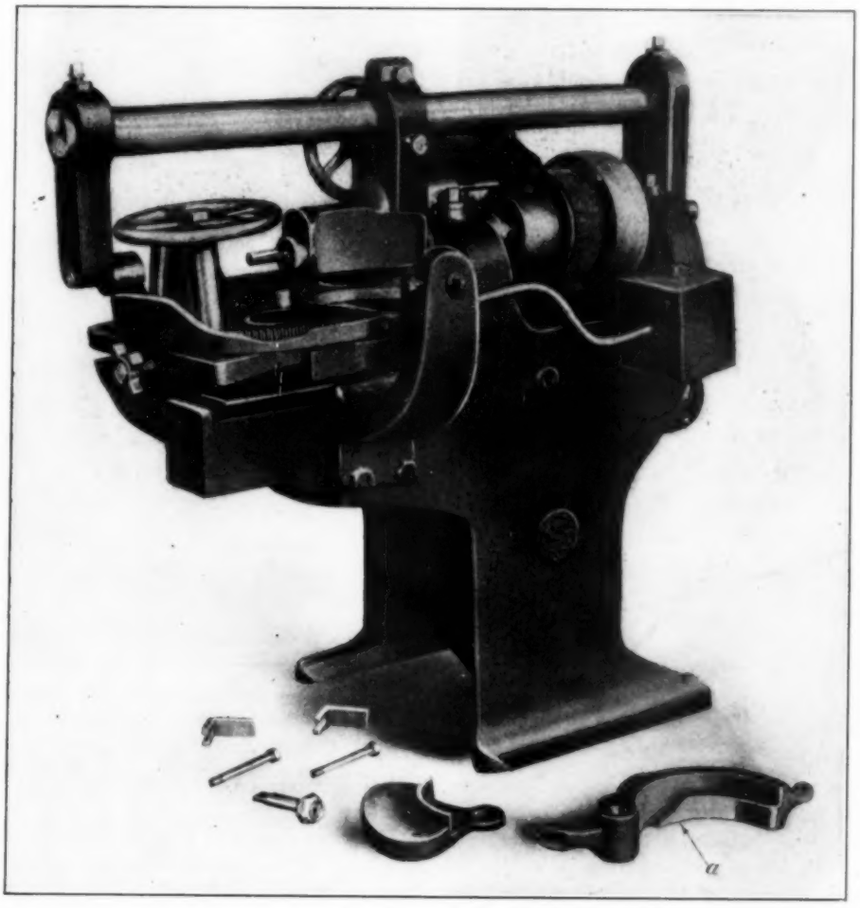
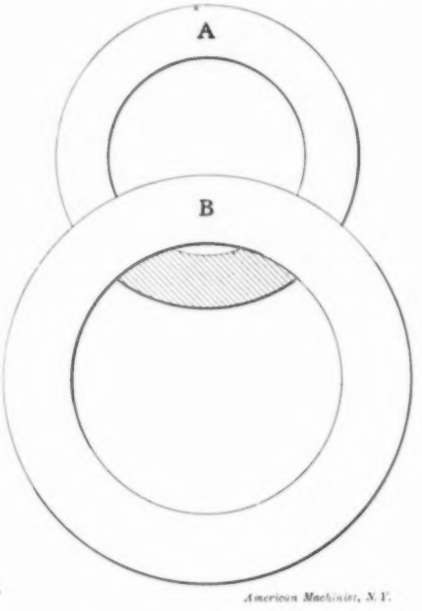


FIG. 2. SPECIAL CAM PROFILING MACHINE

A Peculiar Case of Wear

By R. E. Blain

A lathe spindle for a fourteen-inch lathe was returned to be replaced with a new one. The thrust collars were arranged in the usual way, a cast-iron collar keyed to the spindle and the hardened-steel one running loose and bearing against a bronze box. This steel washer



A PECULIAR CASE OF WEAR

B had cut the spindle *A* three-fourths through. The boring-tool marks on the inside of the ring were fresh and showed no sign of brightness nor wear.

Why did it cut and how?

Large Work on Cleveland Automatics

Samples of Work Done, Time Consumed, Metal Used and Tools Needed in Machining Them. Cost as Compared with Other Methods

EDITORIAL CORRESPONDENCE

The work that is turned out of the solid bar on the automatic turret lathe has had a continual increase in size since the advent of this machine tool, and today pieces are being made of a size that would have been considered very unpractical and not at all economical but a few years ago.

Some of the largest work of this kind is now being done by the Cleveland Automatic Machine Company, on its own automatics in its own shop at Cleveland. A few of these pieces are illustrated and described in this article. The group of eight pieces, shown in Fig. 1, gives an idea of the work that is here being turned out.

On the largest of these pieces there is a large amount of metal removed from the center, and consequently there is a great deal of steel wasted or sold in the form of chips and shavings. In spite of this fact, however, the finished pieces are produced at less cost than they could be forged into shape and then machined.

The cost of the steel used from the bar to form these pieces on the automatic machine, about equals the cost of drop forgings when formed into shape for the same pieces. Here the comparison ends as there is no setting of each piece in jigs or chucks as there would be with forgings, and the machine work is done so much more quickly that the final cost of the finished piece is considerably less.

Time and Tools Used in Machining

When using steel that contains from 0.10 to 0.25 per cent. carbon, the piece shown at *A*, Fig. 1, is made at the rate of one every 18 minutes. This piece is 2 inches long, and is turned from a bar 4¼ inches in diameter, on the Cleveland 4¼-inch turret machine. The tools required are a forming tool to turn the outside down to its proper shape and size, while the stock on the inside is removed, first, by a drill that is about 2¼ inches in diameter; then by a counterbore to rough out the stock; next by a boring tool that cuts the hole nearly to its proper size; and lastly, by a reamer which finishes the hole to its correct size of 3⅝ inches diameter. Usually about 1/32 inch in diameter is left for reaming, but sometimes more than this is needed owing to chips clogging on the point of the boring tool and thus causing it to cut deep creases in the surface of the piece. The final operation is performed by the cut-off tool which cuts the piece off of the bar.

The piece shown at *B* is made at the rate of one every 26 minutes. It is 4 inches long, with a ⅞-inch hole through the center, and is made from a bar 4¼ inches in diameter, in the 4¼-inch turret lathe. The tools used are a forming tool, an oil-tube drill, a boring tool, a reamer and a cut-off tool.

The piece shown at *C* is made in 18 minutes. It is 2½ inches long and is made from a bar 4⅜ inches in diameter, on a 4¼-inch turret machine. It is bored out to the same diameter as the piece shown at *A*, and the cutting tools used are the same as those used for this piece, except that the outside forming tool is of a different shape.

The piece shown at *D* was made in 60 minutes from a 6½-inch bar of steel, on the 6¾-inch turret machine. It is 4½ inches long when finished, and the cutting tools required to make it were an outside forming tool, an oil-tube drill, a counterbore for rough boring, a boring tool for the finishing cut, a combination taper and straight reamer that was 4⅝ inches diameter on the straight part, and a cut-off tool.

The piece shown at *E* takes 64 minutes to make. It is 4 inches long and is made from a bar 6½ inches diameter, on the 6¾-inch turret machine. The tools used in making this piece are a forming tool,

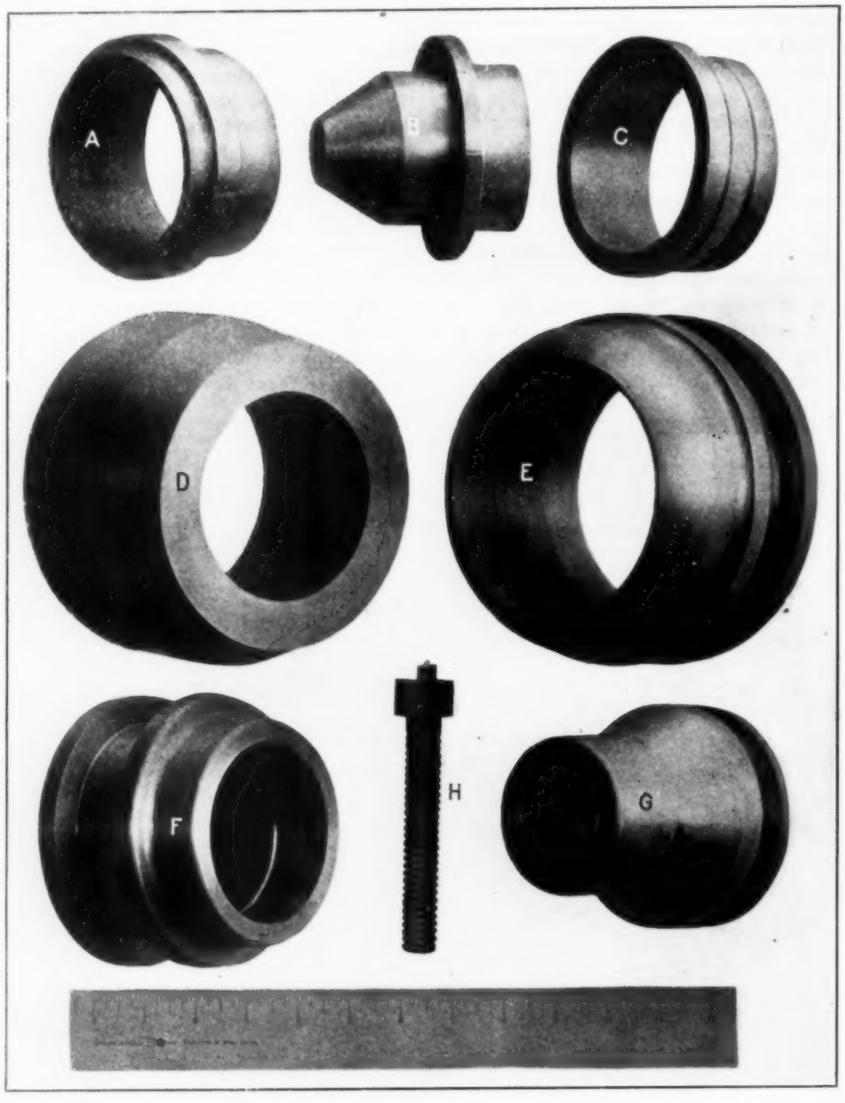


FIG. 1. SAMPLES OF WORK DONE ON CLEVELAND AUTOMATICS

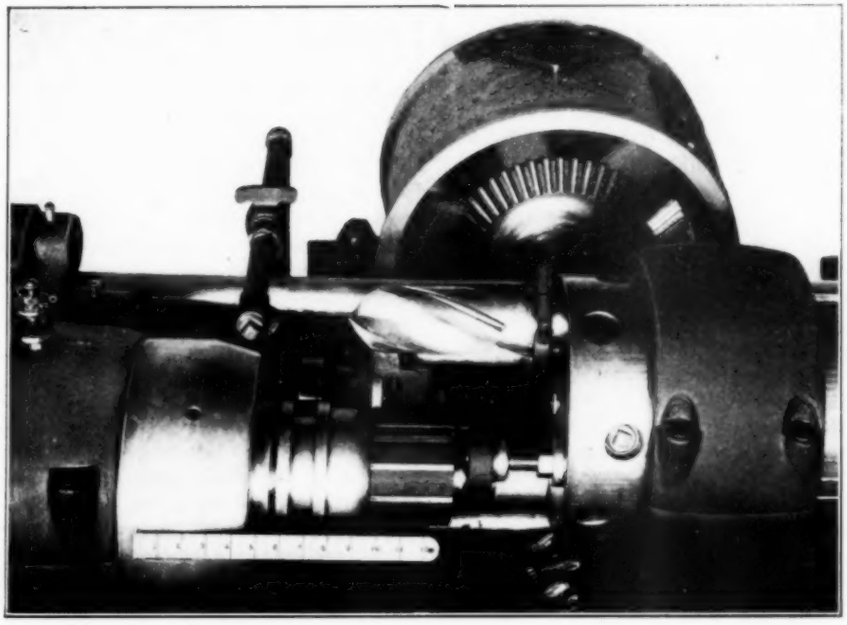


FIG. 2. TOOLS SET TO MACHINE PIECE "E" ON 6¾-INCH TURRET MACHINE

an oil-tube drill, a counterbore for roughing, a boring tool, a reamer 4⅝ inches in diameter, and a cut-off tool.

SPECIAL TOOL HOLDER

The 6¾-inch Cleveland turret machine, as it is set up, while making the piece marked *E*, in Fig. 1, is shown in Fig. 2. The drill shown at the top of the turret is 3 inches in diameter. Back of this, almost hidden, is the rough counterbore, and below that is the boring tool, while

FIG. 3. SPECIAL TOOL HOLDER

the 4⅝-inch reamer is shown as it is entering the hole.

For this job the special tool holder shown in Fig. 3 is used to hold the outside forming tools. It lies against the end of the turret, grouped in the midst of the other tools, and is clamped to the stem of each tool by the set screws in the five ends. This makes a very rigid tool holder, and with it 1⅜ inches has been peeled off, in one cut from each side of bars from 4 to 6 inches in diameter, thus reducing the diameter 2¾ inches.

One of the two tools shown in the tool-holding end takes a roughing cut and the other a finishing cut, thus making two tools that are held rigidly by it. In one division of the turret the roughing tool is brought into position and this is then moved out and another division brings the finishing tool into place to do its cutting. In making large pieces on the automatics the holder is used quite extensively.

This tool holder can be used in conjunction with the tools in the turret below, thus the turning and drilling, and

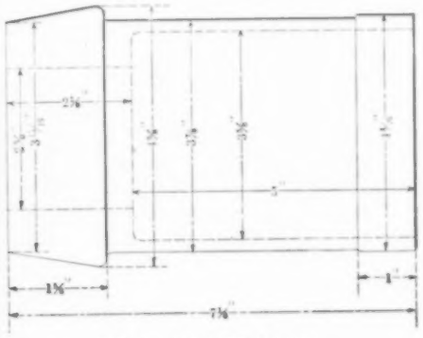


FIG. 4. A LARGE COLLET

the turning and boring, or any other operation, can be done simultaneously. This attachment fits in very nicely for the making of large pieces when the reduction in diameter, of the end of the bar, is very large.

OTHER PIECES MACHINED

The piece marked *F*, in Fig. 1, differs from the others in that it is bored out to two different diameters. This piece is 3¾ inches long and is made from a bar that is 5½ inches in diameter, on the

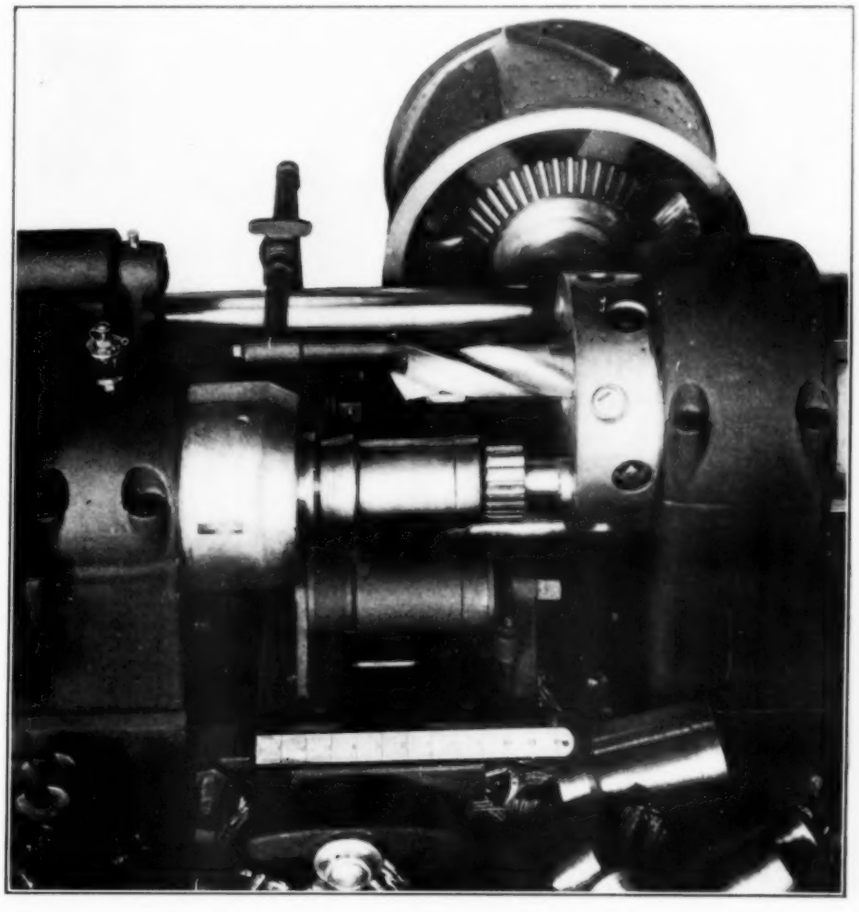


FIG. 5. TOOLS AS SET TO MACHINE COLLET

6-inch turret machine, in 35 minutes. The tools used are a forming tool, an oil-tube drill, a counterbore that roughs out both inside diameters, a boring tool that bores them to the right size for the reamer, a combination reamer that finishes both diameters of the hole to their sizes of 3 3/16 and 3⅜ inches, respectively, and a cut-off tool.

The piece marked *G* is made in 28 minutes. It is 4¼ inches long and made from a bar 4¼ inches in diameter, on the 4¼-inch turret machine. This piece is also finished to two different diameters on the inside and the tools used are a forming tool, an oil-tube drill, a counterbore that roughs out both diameters, a boring tool that does the same, a combination reamer that finishes both diameters to their respective sizes, namely, 1 15/16 and 2⅞ inches, and a cut-off tool.

The piece marked *H*, while small, gives an idea of what these machines do on threaded work. It is 4¾ inches long and is made out of 1¼-inch round bar, on the 1¼-inch turret machine, at the rate of 14 per hour. It has a square thread and the head is nurled. The tools used are a forming tool, a box mill, a nurling tool, a die, and a cut-off tool.

The Collet Case

The collet chuck case shown in Fig. 4 in detail, and in Fig. 5, as it is being machined in the 4¼-inch turret machine, is the largest piece that is being made at the present time. It is made from a bar 4⅝ inches in diameter and is 7⅛ inches long. The forming tool takes a single cut the entire length of the collet, as is shown by the cutter that is located in front of the collet that has been formed in Fig. 5.

This piece is made of 40-point carbon steel in 1 hour and 10 minutes. The tools used are the forming tool, a 2¼-inch drill, a counterbore, a boring tool, a reamer, and a cut-off tool. With a lower carbon steel this time could be considerably reduced.

When we consider that something over 25 pounds of metal are removed in the making of this piece and that, with the operating cost of the automatic only 1 mill a minute, the labor cost is only about 7 cents; it means that a large saving has been effected over the old methods of doing this work in the power, or even in the turret lathe.

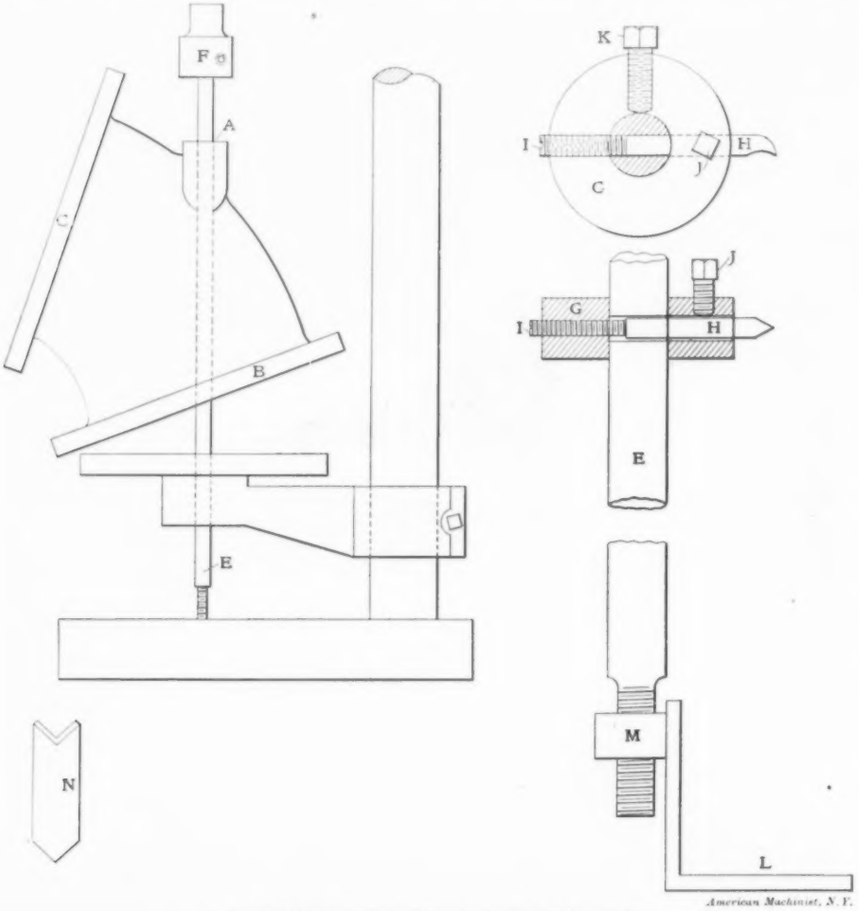
The same relative results as to labor cost and metal removed are also applicable to the other pieces described above.

E. F. L.

A Thread Cutting Job in the Drill Press

By Stanley Gould

Inclosed find sketch and description of a job which is a little out of the regular run of work done in a small shop. We recently finished three large cast-iron ells, each weighing about 1000 pounds. The inside diameter was 14 inches, the flange on one end was 21 inches in diameter by 1¼ inches thick, and the flange on the other end was 42 inches square by 1¼ inches thick. The included angle between the two flanges was about 50 degrees. On the outside curve of the ell was an opening *A* tapped for a 4-inch standard pipe, at an angle of about 70 degrees to the face of the round flange.



A THREAD-CUTTING JOB IN THE DRILL PRESS

Facing the Flanges

We faced the round flange *B* in a 36-inch lathe by bolting the fitting to the lathe carriage and fastening a cutting tool to one of the chuck jaws. The square flange *C* required no facing. The 4-inch pipe thread was cut in a 26-inch drill press, which had a reverse belt used in tapping. A 4-foot length of 1 7/16-inch shafting *E*, the size of the hole in the drill table, was turned down on one end to ⅞ inch diameter by 2½ inches long to go in the drill chuck *F*. The other end was turned to 1 inch diameter and threaded eight threads standard, the thread being about 7 inches long.

A cutter head *G* was made of a cast-iron collar, as shown, the hole which holds the cutting tool *H* being drilled through the bar also. A ⅜-inch screw *I* with a slot for a screwdriver was put in to adjust the cutter for depth of cut. Another ⅜-inch set screw *J* held the cutter firmly in place. A ½-inch set screw *K* held the collar to the shaft.

Operations in the Drill Press

The fitting with the flange at the proper angle to the drill-press table was bolted down securely. The boring bar was held in the chuck and passed down through the hole in the table, the threaded end coming about 8 inches from the base of the press. The fitting was bored to proper size for threading with a tool held in the cutter head and using the regular drill feed. An angle plate *L* was then bolted to the base of the press. On this was bolted a dolly box *M* tapped out to fit the end of the bar. This gives the feed to cut the thread by, a 4-inch pipe having eight threads to the inch. A cut was taken through with the thread tool, the press stopped, and before reversing, a piece of sheet iron *N* was placed in the chuck on the same side of the bar as the thread tool was, so when the chuck was tightened up, the bar was sprung over to one side, which slightly relieves the thread tool, permitting the press to be reversed without breaking the point off the tool. When the tool had reversed out of the cut the sheet-iron shim was removed and the screw back of the cutter set up a little before taking the next cut. This operation was repeated, about eight cuts being required to finish the thread.

Welding with the Oxygenite Process

Apparatus and Materials Used. Cutting Steel. Time and Cost of Gases in Welding Different Jobs. Work Done at Fore River Ship Yards

BY E. F. LAKE

The oxygenite process of welding is one that autogeneously welds metals by the use of oxygen and acetylene gas that are forced under pressure through a specially constructed blowpipe or torch.

It differs from other autogenous welding processes in the generation of its oxygen. Oxygenite is a powder, resembling fine, gray sand, that contains a large amount of oxygen.

This oxygen is liberated by the heat generated by the combustion of carbon mixed with the oxygenite, the combustion taking place in a closed vessel. Each pound of oxygenite gives off about 5 cubic feet of oxygen gas which at the same time stores itself under a pressure of from 150 to 200 pounds, according to the apparatus used. This does away with the necessity of a compressor when the apparatus is used for welding metals, but when thick metals are to be cut an oxygen pressure of about 300 pounds per square inch is needed, and means are then adopted to store the oxygen at this pressure.

One hundred parts of crystallized potassium chlorate to 13 parts of the best quality manganese dioxide, by weight, are usually used to generate the oxygen from. Some put this in a closed receptacle and apply heat to the outside of it to make the chemicals give off their oxygen.

In the oxygenite process, however, carbon is added to the mixture that gives off the oxygen, combustion is started by means of an ignition powder, and the retort is then closed. The combustion continues in the closed retort, due to the supply of oxygen generated. The carbon dioxide is removed by passing the oxygen gas through a scrubber. This scrubber, or washing and cooling device, is a steel tube that is filled with inert substances, over which a solution of caustic soda is poured through a funnel and a two-way cock. The oxygen gas bubbles up through this and is thoroughly cleaned after which it passes into the storage tank.

Oxygen-generating Apparatus

The three standard styles, or more correctly speaking, the three sizes of the stationary oxygenite apparatus are shown in Figs. 1, 2 and 3. Fig. 1 shows the smallest size which has a capacity of 50 cubic feet at 140 pounds pressure; Fig. 2 shows the medium size, with a capacity of 175 cubic feet; and Fig. 3 is the largest size with a capacity of 350 cubic feet.

In Figs. 1 and 2 the oxygen generator is in the center, and this is surrounded by the scrubber, which in turn is surrounded by the oxygen storage tank. This makes a very compact oxygen outfit; the small size taking up a floor space of 18x24 inches only, while the medium size occupies less than 3 feet square. The small size is about 6 feet high while the medium is about 7 feet from the floor to the top.

The largest size, which is shown by Fig. 3, is constructed differently, as the generator, the scrubbers and the storage tank are separate. This is about seven feet in hight, over all, and occupies a floor space of about 4x6 feet. In charging the generator the tightening screw *A* is loosened, the clamp *B* swung off the cover, the cover *C* taken off and the basket that holds the oxygenite taken out. This basket is a tube that is perforated around the sides to allow the oxygen to escape. This basket is lined on the inside with a special kind of asbestos cloth and the oxygenite filled in flush with the top. The basket is then placed in position inside of the generator, the ignition powder lighted with a match, the cover clamped on, and the combustion which takes place inside of the generator releases the oxygen from the powder.

This oxygen then flows out of the top of the tank, through the pipe *D*, into the bottom of the scrubber *E*. From the scrubber *E* it passes through the pipe *F* into the second scrubber *G* and from the second scrubber *G* through the pipe *H* into the storage tank *I*. In the smaller sizes but one scrubber is used which, however, is of a comparatively larger size.

On top of the generator at *J*, and the storage tank at *K*, are located safety valves, and at the bottom of the scrubbers are located drain cocks *L*. For

FIG. 1. SMALL OXYGENITE APPARATUS CAPACITY 50 CUBIC FEET

FIG. 2. MEDIUM SIZED APPARATUS CAPACITY 175 CUBIC FEET

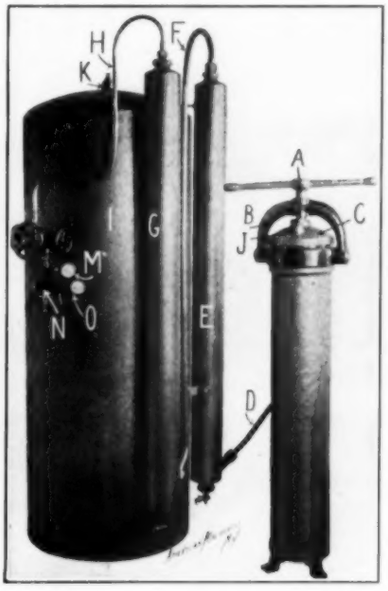


FIG. 3. LARGE SIZED GENERATOR, SCRUBBERS, AND STORAGE TANK CAPACITY 350 CUBIC FEET

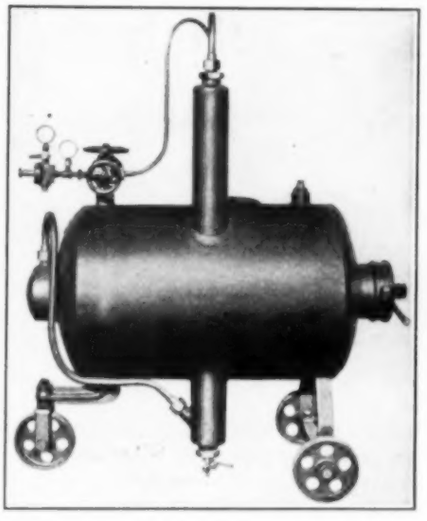


FIG. 4. PORTABLE OXYGENITE APPARATUS, CAPACITY 75 CUBIC FEET

controlling the oxygen gas an indicator is located at *M*, which shows the pressure in the tank; and a pressure regulator, or reducer, is located at *N* with its indicator gage *O* for the purpose of giving the proper blast to the gases as they come from the blowpipe.

A portable apparatus for generating oxygen from oxygenite and storing it until used is also made by this same company. This has a capacity of 75 cubic feet and is shown in Fig. 4. The upright tube that runs through the storage tank is the scrubber. This apparatus occupies a floor space of about 2½x5 feet, and is about 6 feet high over all.

Operation of Generator

For the supply of acetylene gas to use in conjunction with the oxygen for welding and cutting metals, the same acetylene apparatus that is used by others, is used with the oxygenite process, and as this is so well known it will not be described here.

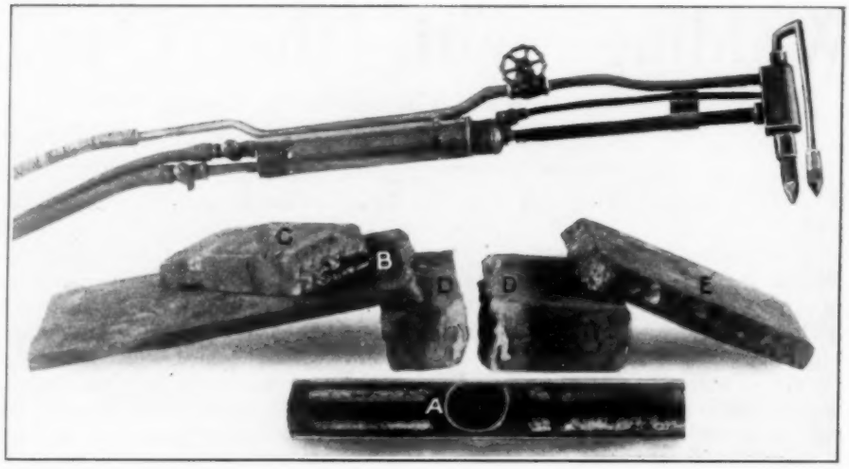


FIG. 5. TORCH WITH CUTTING ATTACHMENT AND SOME PIECES CUT

The torches used with the apparatus are very similar to those used by others and 34 nozzles are furnished with each torch so that any desired thickness of metal or style of welding can be done. For cutting metals an extra attachment and tip is added to the torch, as shown in Fig. 5. This is for furnishing the extra supply of oxygen that is needed when cutting metals of considerable thickness.

The metals shown in front of this torch were cut by it. The piece *A* is a pipe with the metal ⅛ of an inch thick and the hole cut out is 1¾ inches in diameter. *B* is a ½-inch thick steel plate; *C* is 1⅜ inches thick; *D* is 2 inches thick; and *E* is 1 inch thick.

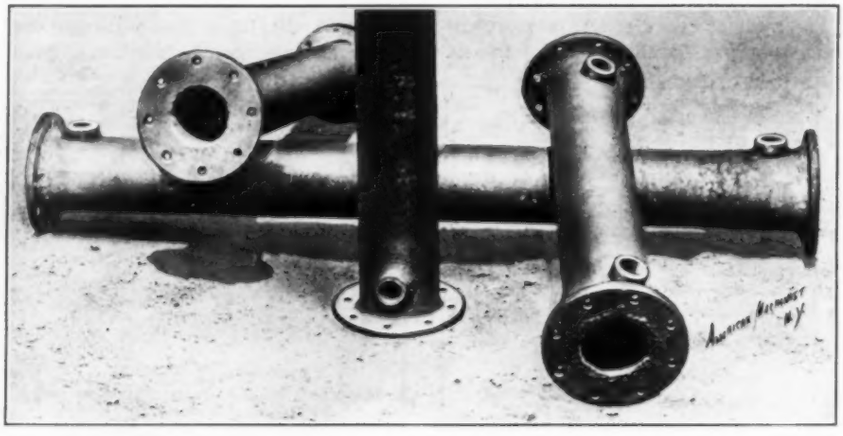


FIG. 7. WELDING FLANGES AND NIPPLE BRANCHES ON CAST PIPE

Samples of Welding

The Fore River Ship Building Company has applied this process to the manufacture of their ventilating pipe for boats, as well as to other kinds of work, and Fig. 6 shows a few of their many sizes and shapes of welded ventilating pipes. The pipes are made of thin metal that was

With this system a continuous supply of oxygen can be kept up by simply filling the retort with oxygenite and lighting it, when the pressure in the storage tank has been reduced to a point that is too low for welding. The reaction that takes place from the combustion in the oxygenite retort is concluded in from 20 to 60 minutes according to the size of the charge, and the pressure in the storage tank resulting from this is from 120 to 200 pounds per square inch. In welding metals the oxygen can be used until this pressure has been reduced to from 10 to 30 pounds, according to the kind of metal operated on, before another charge of oxygenite is necessary.

The oxygen in the storage tank never exerting a pressure of more than 300 pounds per square inch, and this pressure usually being below 150 pounds, the danger of the explosion of oxygen tanks is almost entirely removed.

The simplicity of this process has made it possible for the ordinary workman to operate it and easily do efficient welding with a little practice.

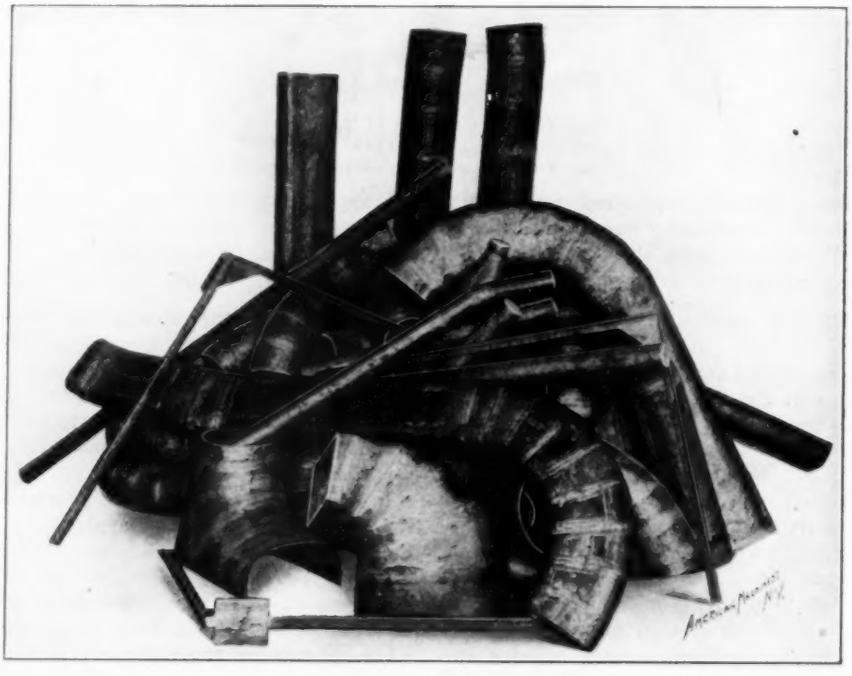


FIG. 6. SOME SAMPLES OF WORK WELDED BY THE FORE RIVER SHIPBUILDING COMPANY

FIG. 9. GROUP OF IRON CASTINGS WELDED WITH THE OXYGENITE PROCESS

formerly riveted, but the autogenous welding of these joints proved to be so much cheaper that the large building in which they are made was fitted up with the oxygenite process and all of the pipes are now welded. The process is also used for different kinds of work in other parts of the plant and the uses to which it is put are continually increasing.

The cast-steel pipes shown in Fig. 7 have a flange and a nipple welded on each end. These pipes are 3/16 of an inch thick, the flanges are ½ inch thick and ⅜ inch couplings are welded on the side after the hole has been cut through the pipe with the torch. The time consumed in welding and cutting both ends of each pipe was 2 hours and 30 minutes and the cost of the gases was $3.44. Eight of these pipes were welded in 20 hours with a cost of gases of $27.52.

Steel Tubes

The sheet-steel pipes shown in Fig. 8 had branches and glands welded on, and ends welded in. Pipes 1 and 2 are 2¼ inches in diameter, and ¼ inch thick; the branches are 1 inch in diameter and 3/16 inch thick. On each branch as shown at *A* there are 4 inches of welding, and this is done in 2 minutes, with a gas cost of 4 cents. The ends *B* are ¼ inch thick and each requires 7 inches of welding. This was done in 10 minutes, with a cost of gases of 22 cents. The glands *C* are 1 inch thick, required 4 inches of welding and were welded on in 5 minutes, with a gas cost of 8 cents.

Pipes 3 and 4 are 3⅝ inches diameter, ¼ inch thick, and the branches 2, 2½ and 3 inches in diameter respectively, and ¼ inch thick. Branch *D* has 8½ inches of welding and was welded on in 12 minutes with a cost of gas of 20 cents; branch *E* has 10 inches of welding, was welded in 14 minutes with a gas cost of 22 cents; and branch *F* has 13 inches of welding and was welded in 16 minutes, with a gas cost of 24 cents. The ends *G* are ¼ inch thick, had 11½ inches of welding each, and they were each welded in 16 minutes, with a gas cost of 25 cents.

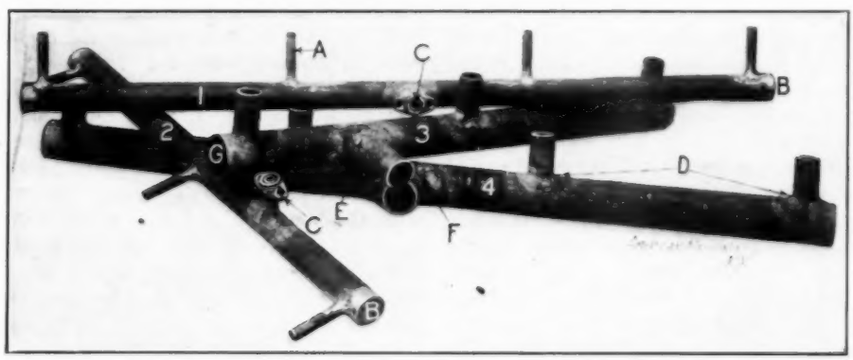


FIG. 8. WELDING BRANCHES, GLANDS AND ENDS ON SHEET STEEL PIPE

Iron Casting

This apparatus is very useful for repairing iron castings, as well as steel, as is shown by the group of iron castings in Fig. 9. In this the piece marked 1 was "cold shorted" in the mold, and instead of throwing it away, new metal was melted and fused into the openings that did not fill in the mold, as is shown by the rough metal on the side and top of the casting. It took 2 hours to weld this piece and the cost of the gases was $1.90. This was rather a difficult piece to mold, owing to the intricate cores, and therefore it was cheaper to weld it than to scrap it and make a new one.

The piece marked 2 had two bosses welded on the side and pieces from 3 to 12 had blow holes, sand holes, cracks, and flaws filled up as can be seen in the cut. The entire lot of pieces from 2 to 12, inclusive, was welded in one hour and the gases used in this welding cost 85 cents.

In welding cast iron a special iron that is high in silicon is usually used in the form of a rod, as this shape and composition of iron can be the more easily fused into the opening to be welded and leave the metal at the joint soft.

FIG. 11. TANKS MADE BY WELDING TWO SEAMS LENGTHWISE AND TWO ENDS ON

Cast iron can be welded to steel or other metals, and *vice versa*, but this requires considerable skill and knowledge, as the metal to be used in making the weld should be the one of the two to be joined that has the lower melting point. For instance, it is very nearly impossible to weld cast iron to wrought iron, or steel, by using a welding rod of either wrought iron or steel, while it can be easily welded to either of these two by using a cast-iron welding stick, and a good, strong joint will be the result. Some of the nonferrous metals, such as copper, bronze, etc., can also be welded to iron or steel by using a welding rod of the metal with the lowest fusion point. The metal used for the welding stick is annealed by the melting it receives, if the weld is allowed to cool

in the air, and, therefore, its degree of hardness is not a consideration.

Steel Tanks

In the making of steel tanks, barrels, and similar work, autogenous welding has been a great aid in the reduction of cost and the making of a perfectly tight joint.

The tank shown by *A* in Fig. 10 is 12¾ inches in diameter and the sides are 5/16 inch thick. The ends or heads that are welded in are 1½ inches thick, and the distance around the circumference of each head was 40 inches. This 40 inches of welding was done in 2 hours and 30 minutes with a supply of gas that cost $6.24.

The tank marked *B* in Fig. 10 was 12¾ inches diameter, with sides that were ½ inch thick. The heads were 1½ inches thick, and the 40 inches of welding on

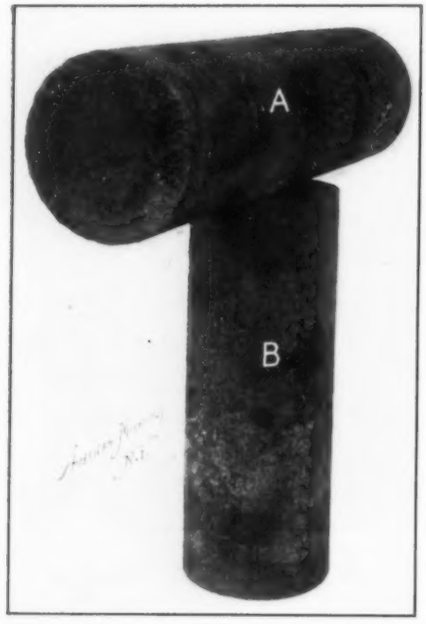


FIG. 10. TANKS 12¾ INCHES DIAMETER WITH FLAT HEADS WELDED IN

each of these took 2 hours and 45 minutes, and consumed gases that cost $6.61.

The tank shown in Fig. 11 is 46 inches in diameter, and there are two long seams, lengthwise of the side, each of which is 7 feet 8½ inches long. This 15 feet and 5 inches of welding was done in 3 hours and 18 minutes with a gas cost of $8.06.

The two ends were welded in with a lap joint. That is, the top, as shown, was conical shaped with a flange turned in on it that just fitted the inside of the tank, while the bottom was flat, with a flange turned up on it that also fitted inside the tank. This leaves the two sheets of metal to be welded back to back. Metals that are quite thick can be satisfactorily welded into an absolutely tight joint in this manner, as the heat from the torch is very penetrating and welds clear through the outer sheet.

There is 12 feet of welding around the circumference of each of these ends, and the 24 feet of welding was done in 6 hours, while the cost of the gases was $12.48.

Summary

With this oxy-acetylene process of welding the temperature of the flame is something over 6000 degrees Fahrenheit, yet if the metals are properly welded there is no danger of burning them as the heat is quickly scattered by radiation. For this reason many joints which have been welded and then tested by pulling the metal apart, will break entirely outside of the zone which was heated. With many other welding processes the heat is radiated too fast to allow enough local heating to produce fusion. Torches with different sized tips that produce flames of different sizes are, therefore, needed for metal of different melting points and conductivity.

When butt welds are made the metal should be beveled on both sides of the weld at an angle of about 45 degrees. This gives a V-shaped trough of about 90 degrees in which to melt the welding bar and fuse it with the metal to be welded. The metal on each side of the weld should be melted as far back from the joint as will equal the thickness of the metal welded to insure perfect fusion. It has been pretty well demonstrated that much more or less than this does not produce a good weld.

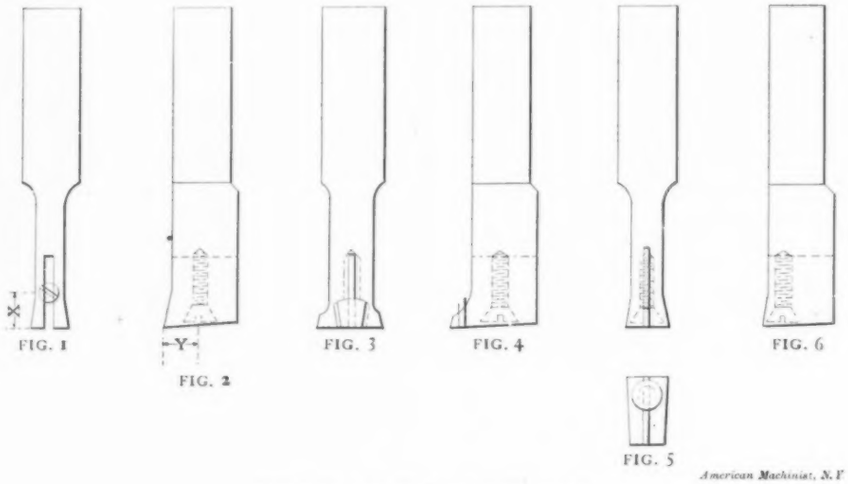
In welding most metals the metal should be preheated to a considerable distance from the weld in order to avoid shrinkage cracks. This should be done by giving the torch a circular motion so as to avoid local heating; and this motion should also be given the torch in welding to prevent an overheating of the treated spot. The heat would naturally focus in the center of the circle instead of spreading out when it strikes the metal, and this would make it more easily controlled as the metal at the desired point would be quickly heated.

The process is controlled by the Industrial Oxygen Company, Hanover Bank building, New York.

Adjustable Slotting and Slot Planing Tools

In the American Machinist on page 64 there appeared an article about expansion slotting tools. The illustrations, Figs. 1 and 2, had appeared before in the way shown. The writer of the last article claimed correctly that a tool made this way would not work as the distances *X*, Figs. 1 and 2, would be too great, and that for this reason the cutting points would spring together. The writer, therefore, showed another tool like Figs. 3 and 4, but as this tool would be a more costly one, I would like to say a few words about the first two shown. They would both work well if only made right. There is no reason for leaving the distances *X* as large as shown in Figs. 1 and 2. I have shown the tool, Fig. 2, as it would appear when made right in Figs. 5 and 6. This tool I would recommend for planing slots, as when used in a planer the chips come in contact with the front edge, which is in this tool left smooth. The tool shown in Fig. 1, made with the screw as near the bottom edge as possible, would be better for use in a slotting machine, as there the chips come in contact with the bottom of the tool which will, in this case, be smooth. It should be understood that when using any of these tools, a solid tool must first be used to cut down with to the required depth, for they all have the center cut away and are, therefore, made for sizing only.

Rome, N. Y. A. Nielsen.



SLOTTING AND SLOT PLANING TOOLS

Nicolson's Universal Machine Tool Dynamometer*

In these days, when the very general use of high-speed steel for cutting tools has made necessary a great increase in the size and strength of lathes, planers and similar machines, it has not always been an easy matter to decide to what extent such strength should be added. It was, of course, known that the pressures on the point of the tool were enormously increased with the advent of high-speed steel, but what the actual increase amounted to was not known. The great importance, therefore, of some ready means of determining the pressures in question was clearly manifest; for it is self-evident that before a machine tool, or any other kind of apparatus which has to turn out mechanical work, can be designed on rational scientific lines the magnitude and the direction of such forces must be fairly well known. In a lathe, or similar machine, the forces that require particular attention are, of course, those due to the size and shape of the cut, and to the speed of cutting, as well as to the form and angles of the tool point. When these different data are known, the remainder of the work of designing presents no particular difficulties. The speed of cutting and the angles of the tool point can, of course, be easily ascertained. The pressures on the point of the tool are, however, not so readily found, and it is on these, it may be said, everything depends.

With the object of determining these pressures, the apparatus which we illustrate has been designed by Prof. J. T. Nicolson, and constructed by Messrs. Joseph Adamson & Company, of Hyde, Cheshire, for use in the Moscow Imperial Technical Institute. It is in reality a universal machine-tool dynamometer, for, in record-

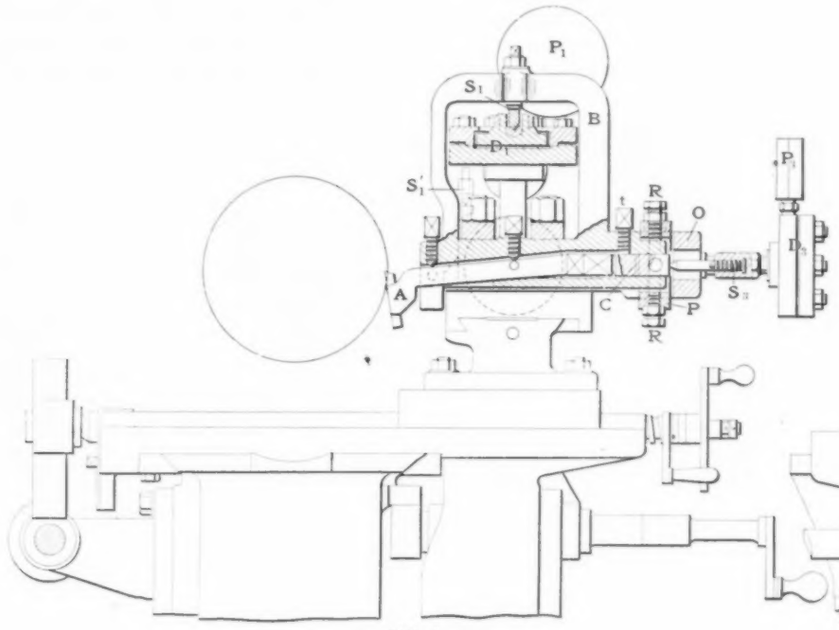


FIG. 1

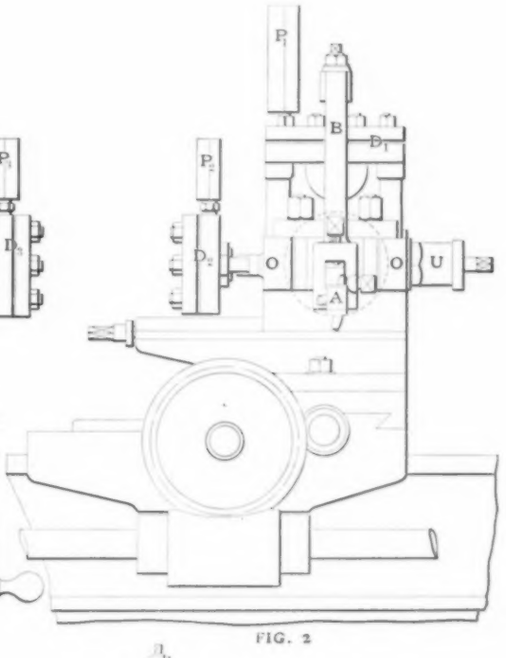


FIG. 2

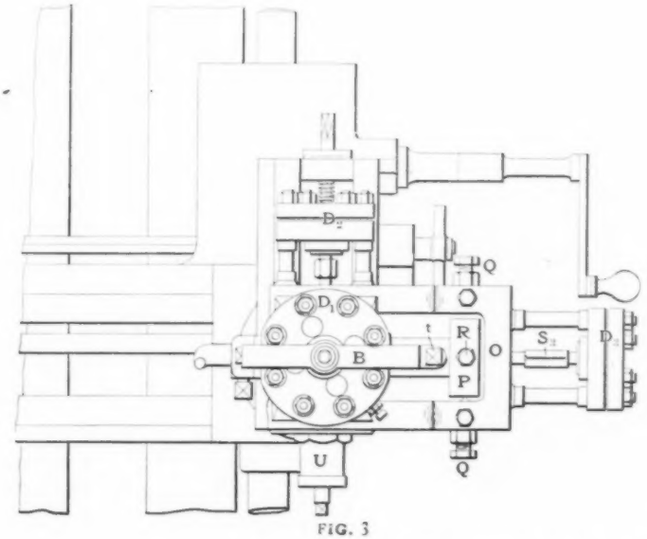


FIG. 3

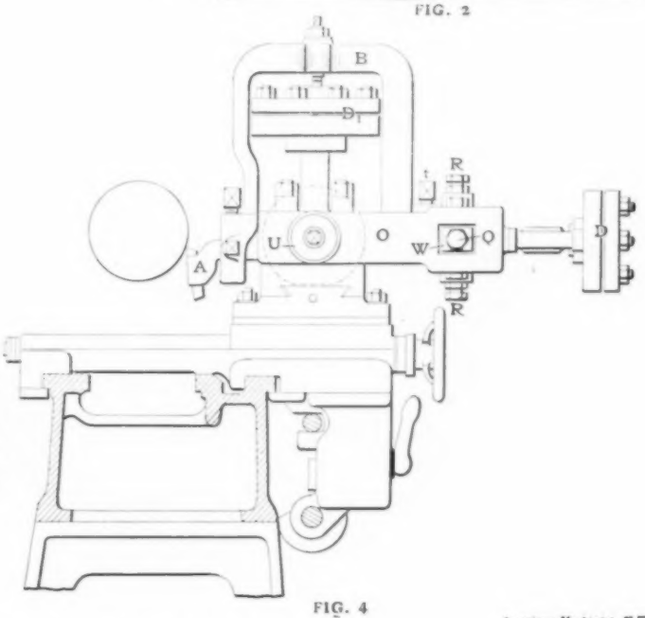


FIG. 4

American Machinist N Y

NICHOLSON'S MACHINE-TOOL DYNAMOMETER APPLIED TO A LATHE

ing one pressure on the point of a tool it does so not only in a downward, but in a side and backward direction. The magnitude of the forces in all three directions having been determined, the amount and the direction of the resultant are known. The first apparatus of the kind was constructed in 1903, but it has since then undergone many improvements. The apparatus which we illustrate has been

*From *Engineering* of London.

made to fit the tool slide of any lathe from 8- to 12-inch centers, and it can also be placed on the tool head of a planing machine of moderate size. Larger machine tools can also be fitted with apparatus of a similar type, suitable for any requirements under special arrangements. In addition to recording the forces we have mentioned, the apparatus may also, with a simple modification, be used for measuring the turning moment and feeding force acting upon twist drills.

Details of Construction

Coming now to a more detailed description of the dynamometer, Figs. 1, 2 and 3 show the apparatus fitted on a 12-inch center lathe, the views, respectively, being a vertical section, an end elevation and a plan. In Fig. 4 a view is given of the instrument fitted on an 8-inch lathe; Fig. 5 shows it fixed to the cross slide of a planing machine, while in Figs. 6 and 7 its adaptation for testing a twist drill is demonstrated. In the last two of these the work is rotated on a face plate in a lathe of suitable size.

Referring to Fig. 1, it will be seen that the tool to be tested is supported in the holder A, but if the tool is made from steel of about 1 inch square section, and not less than 10 inches long, it may itself be placed in the apparatus. By means of set screws, the tool or holder is kept firmly fixed in the floating bridge piece B, the space between the back end of the tool and the sliding piece C being filled in with one or more cast-iron blocks provided. The sliding piece C is pushed forward by means of the lengthening screw S_2 until all the slack is taken up, and is then held by the set screw t.

At the back end the bridge piece is doubly pivoted by means of the pointed screws $Q\,Q\,R\,R$, shown in Figs. 1 and 3, the screws $Q\,Q$ bearing against the gimbal piece P (see Fig. 3), which surrounds the bridge piece. The two pointed screws $R\,R$ pass through the gimbal, and enter the pop centers on the bridge piece, as shown in Fig. 1. They thus form a vertical axis, about which the bridge piece and the tool itself can turn freely about a horizontal axis parallel to that of the work, and formed by the points of the screws $Q\,Q$, which pass through the sliding blocks W, fitting in slots in the frame O, Fig. 4. The foundation of the whole apparatus is formed by this frame, which is firmly bolted to the tool slide by means of the ordinary screws and plate.

When an experiment is in progress the bridge piece is pressed down by the vertical force on the tool due to the cut acting on the point of the tool. This force produces a pressure under the diaphragm of the hydraulic support D_1. Now if the distance from the screws $Q\,Q$ to the tool point, and also the distance from these screws to the axis of the hydraulic support be known, the force acting vertically on the tool can be inferred from the previous calibration of the hydraulic support. The connection between the bridge piece B and support D_1 is made by the pointed stud S_1, so that the ratio between the distances from the screws $Q\,Q$ to the tool point and to the axis of the hydraulic support remains invariable, even should there be slight motions of the bridge piece, caused by the minute deflections of the various diaphragms.

Coming now to the sideway force due to the traverse feed of the tool when taking a cut, this tends generally to push the tool toward the loose headstock. A

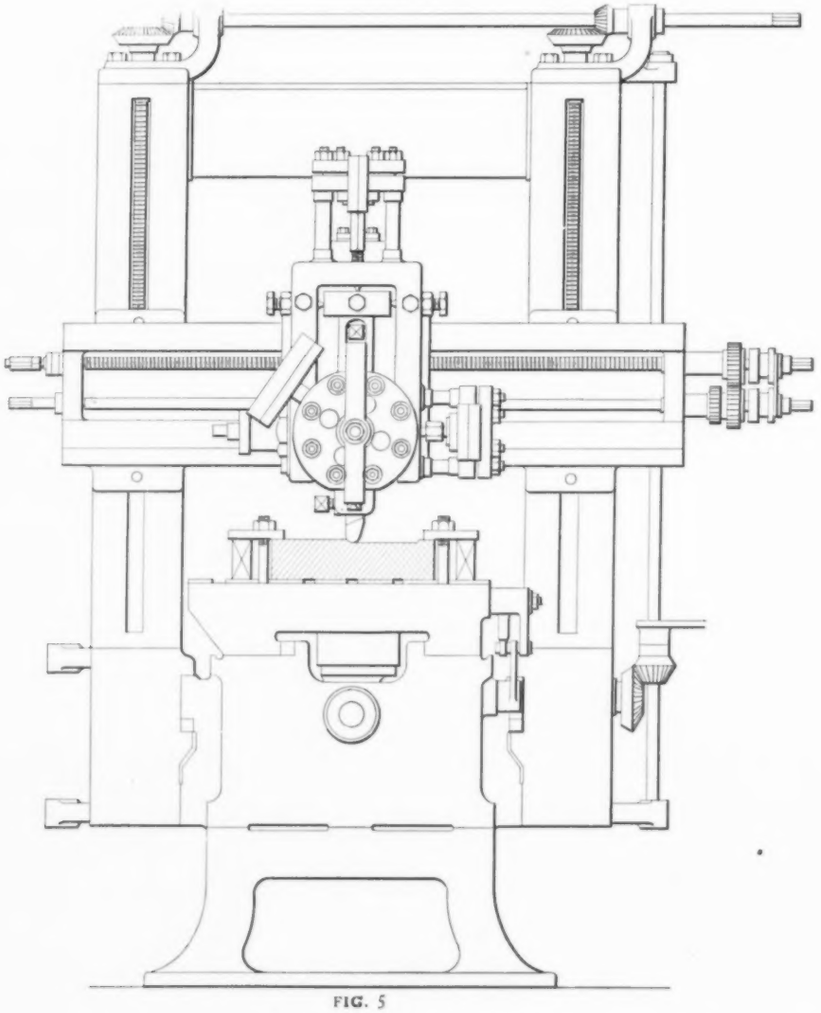


FIG. 5

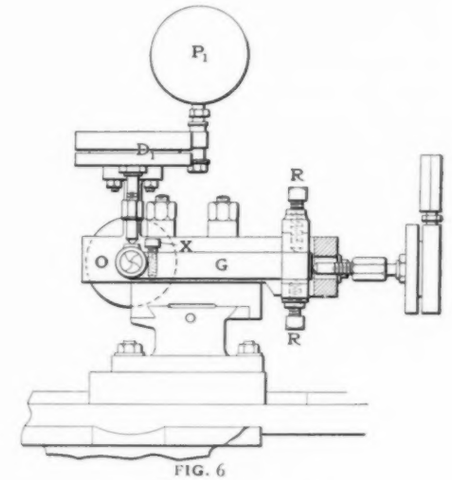


FIG. 6

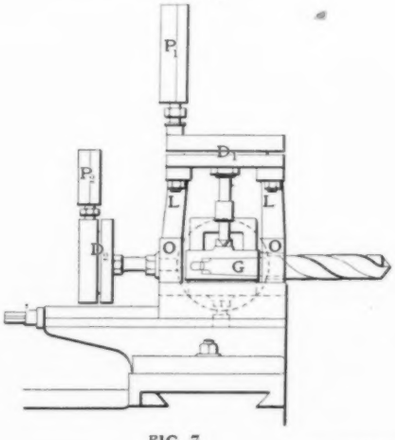


FIG. 7

American Machinist, N.Y.

NICHOLSON'S MACHINE-TOOL DYNAMOMETER APPLIED TO A PLANER AND THE TWIST-DRILL ATTACHMENT

diaphragm support D_2, Figs. 2 and 3, is, therefore, provided for measuring this. The tool then moves about the vertical axis $R\,R$, Fig. 1, and sideway pressure is calculated in a similar way to the downward pressure, just described, by means of the respective leverages. Lateral oscillations of the tool are avoided by putting an initial pressure on the side diaphragm D_2 by means of a compressed spring contained in the box U, the amount of which pressure, of course, being known before the experiment begins, by means of the gage P_2, Fig. 2. During the experiment the initial load on the spring remains practically unchanged, because the alteration in the length of the spring due to the deflection of the diaphragm support D_2 is so small as to not affect the result. The initial pressure on the spring being deducted from the total pressure indicated by the gage P_2 during the experiment, the working force on the tool is found.

In order to measure the backward or surfacing force acting on the tool when cutting a diaphragm D_3, Figs. 1, 3 and 4, is provided, the force from the tool being transmitted through cast-iron blocks and the sliding piece C to the stud S_3, after which it is calculated as before. Before taking a cut, especially when this is a deep one, an initial pressure must also be put on the back diaphragm D_3 by the stud S_3, which causes the blocks W, Fig. 4, to press against the front of their slots, and, as the cut proceeds, the surfacing force first relieves the pressure of the blocks against the front of the slots, after which it is fully indicated upon the gage P_3. In this case no deduction for initial pressure is required. An initial-pressure screw S'_1, Fig. 1, is also provided in connection with the measurement of the vertical force on the tool, for preventing undue vibration of the tool, caused by the deflection of the diaphragm D_1; but this screw is only made use of when deep cuts are taken, or with gapped work.

The method of finding the pressure on the tool of the planing machine, shown in Fig. 5, is similar to that described for lathes. When it is required to ascertain the forces acting on a drill, the latter is inserted in the arm G, shown in Figs. 6 and 7. The drill fits inside the casing $O\,O$, which is pivoted in a gimbal piece by means of the screws $R\,R$; these are pivoted about screws $Q\,Q$, as before explained (see Fig. 3). By means of the set screw X the drill is raised until its axis coincides with that of the lathe. During the experiment, when the drill has entered the hole, this screw may be released. The feed pressure or backward thrust is taken by the diaphragm support D_2, and is measured directly. The twisting force acting on the drill when cutting being in a clockwise direction, of course tends to raise the arm G, Fig. 6, round its pivoted axis $Q\,Q$, and so produces a pressure on the diaphragm support D_1, Figs. 6 and 7. This diaphragm support is similar to that used for the lathe, and illustrated in Fig. 4, except that it is inverted and bolted to the pillars $L\,L$ of the casting $O\,O$, Fig. 7. In the case of the drill the floating bridge piece B is removed. The actual twisting moment is readily found from the length of the arm G between the screws $R\,R$, and the center line of the diaphragm support D_1, and the pressure indicated by the gage P_1.

The whole apparatus is very simple and compact, and with careful usage ought to prove useful in determining the forces which are to be reckoned with when designing machine tools.

Cutting Cam Tracks in Slotter Gears

The cut shows the method used by the Betts Machine Company in turning out cam tracks for slotting machines. The large master cam is in the form of a ring and is bolted fast to the boring-mill table, being turned to fit outside of table, which allows it to be centered easily and quickly.

The gear on which the cam is to be cut is then dropped on the plug fastened in the center of the table and turned until its cam is brought to its proper position relative to the master cam, when it is also then clamped fast to the table. The master-cam roll is bolted firmly to the saddle, as shown, and the feed-screw nut locked open. This allows the saddle and tool to be moved back and forth as the table revolves. Side tools are used for cutting each side separately, leaving about 1/32 inch for the finishing tool, which is shown on the top of the bushing.

This finishing tool is the same diameter as the roll which is to run in the groove, and cuts on both sides of the groove at once leaving the cam slot parallel. It may surprise some to learn that the side tools operated as above will not give a perfectly parallel groove, but a little investigation will soon show that the milled cutter is necessary. The roller arm has different positions on the saddle for varying diameters of gears, two other holes being shown.

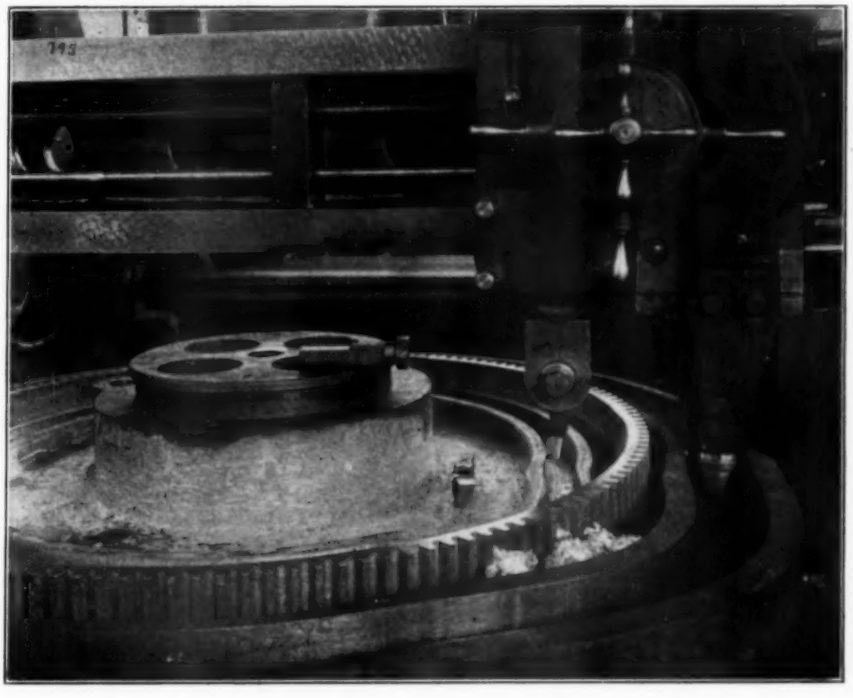
A Handy Bending Form

By Roy H. Grove

We had some ½x2½x9½-inch pieces to bend as shown at A. The blacksmith, who works with his head as well as with his hands, devised a form as shown at B.

A HANDY BENDING FORM

By making X equal the amount of offset required in the pieces, one stroke of the steam hammer did the trick. It was found to be unnecessary to heat the pieces to get uniform results. As we had a great number of these to bend, quite a saving was effected.



CUTTING CAM TRACKS IN SLOTTER GEARS ON THE BORING MILL

Practical Letters from Our Readers

A Round Table Discussing Details of Modern Machine-shop and Drawing-office Methods, Practice and Economy

WE PAY FOR USEFUL IDEAS

Worm Milling Fixture

The illustrations show a special milling fixture for cutting worms on a plain milling machine. The worms are 3-pitch, double thread and 7/8 inch diameter by 1 1/8 inches long. These worms were chased on a lathe, before this fixture was made, with an output of 15 per day, but the mill will cut 57 per day at a cost of $1.87 per 100, a man operating three machines. The cutters that are used on this job are Novo steel with the teeth offset; that is, one side of the tooth only is cutting at a time, making the cut in one operation.

Figs. 1 and 2 show how the worm is carried by the spindle and supported during the cutting operation in a hardened rest. The spindle is threaded the same lead as is to be produced on the worm, the rear box being threaded internally to fit the thread on the spindle and serve as a nut for feeding the work past the cutter. The straight lever, seen in Fig. 1, is for throwing in the feed, connection being made by a clutch, part of which is keyed onto the spindle while the other part is formed on the side of the worm wheel. The collar on the spindle at the side of the clutch trips the lever at the required point, thus throwing out the feed.

The driving pulley is operated from a small pulley on the countershaft by a 3/8 round belt, the drive being transmitted by bevel gears and worm to the worm wheel on the spindle. The rear end of the spindle is squared to receive a crank handle, which is used for turning the spindle back to the starting point. This machine has saved about $2000 during the last year.

Dayton, O. WILLIAM H. RAMSEY.

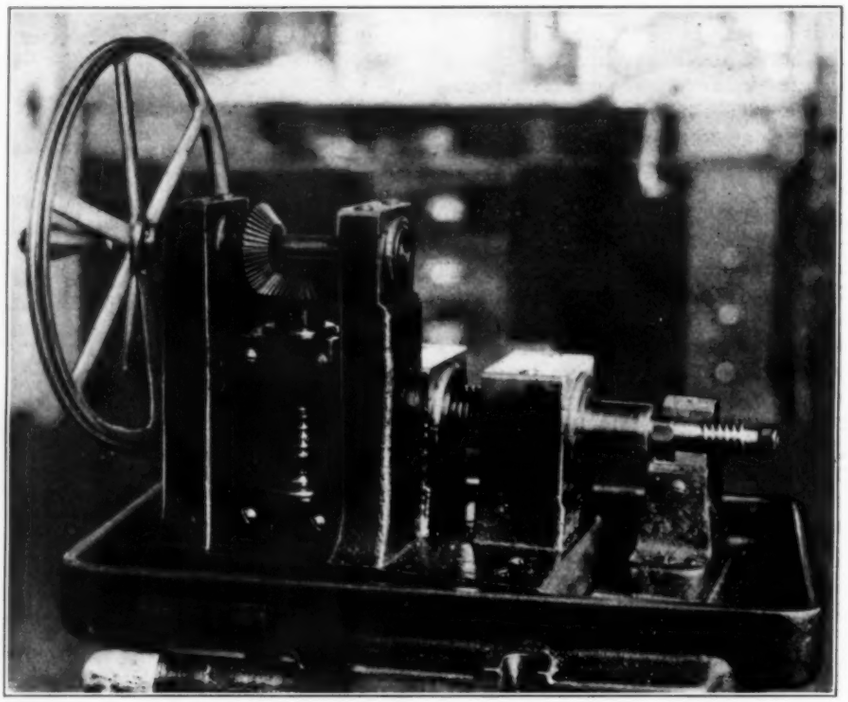


FIG. 2. WORM MILLING FIXTURE

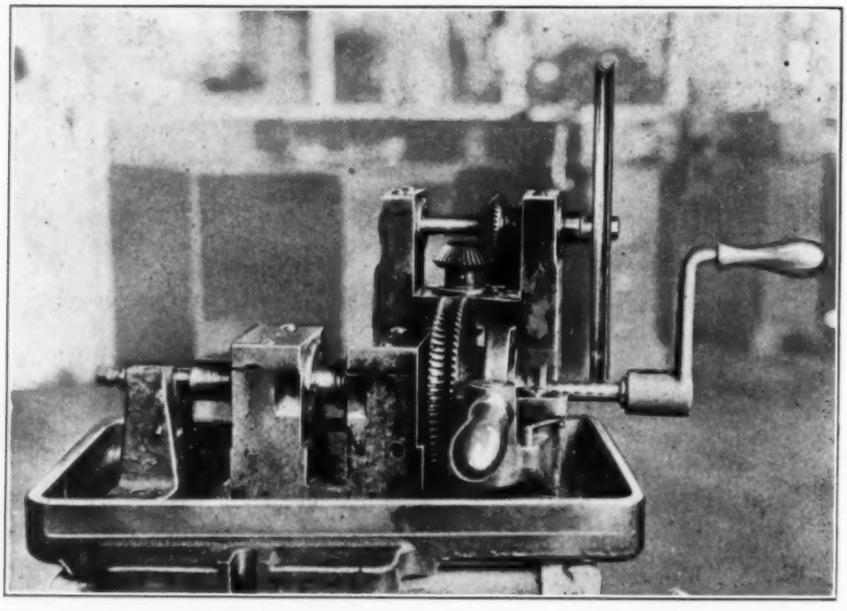
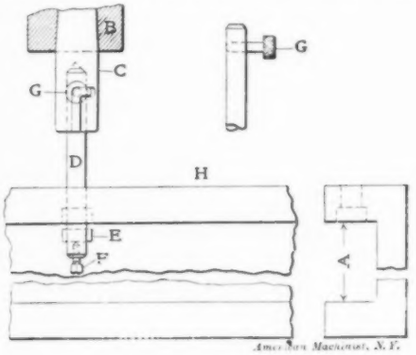


FIG. 1. WORM MILLING FIXTURE

A Back Counterboring Tool

Having occasion to back-counterbore quite a number of pieces *H*, as shown, I find this tool a very good one.

B represents the drill-press spindle; *C* is the collet, which the cutter bar *D* is held in and driven by pin *G*. This pin *G* is fitted loose so that it can be removed with the fingers; this enables you, after the pin *G* has been removed, to remove the bar *D* without taking out the cutter *E*, as the distance *A* is sufficiently wide to allow the bar to be pulled straight down out of the hole. This makes the



BACK COUNTERBORING

counterbores more uniform, as the cutter is never moved.

The collet *C*, of course, could be equipped with the drill and tap, should the work demand it. This tool has been in use quite a while and shows scarcely any wear.

Franklin, Penn. B. M. WELLER.

A Slotting Attachment for Cutting Internal Gears

The accompanying sketches show an attachment for the slotting machine, which we designed for cutting steel internal gears, as shown in Figs. 5 and 6, having 50 teeth, 12 diametral pitch, 9/16 inch face. These gears were wanted in fair quantities, in the time of the motor-tricycle boom, about six years ago, when the art of gear cutting had not developed to the extent it has now reached. Consequently only about three firms in the country specialized on it; they charged you their own price, and made you wait their own time for deliveries, which was not always convenient. Besides, gear cutting as then done was more of a millwright's job, and for small internal gears of fine pitch it was almost impossible to get accurate work, hence the design of this fixture, which completely got us out of the difficulty, and was about the biggest cost reducer I ever saw.

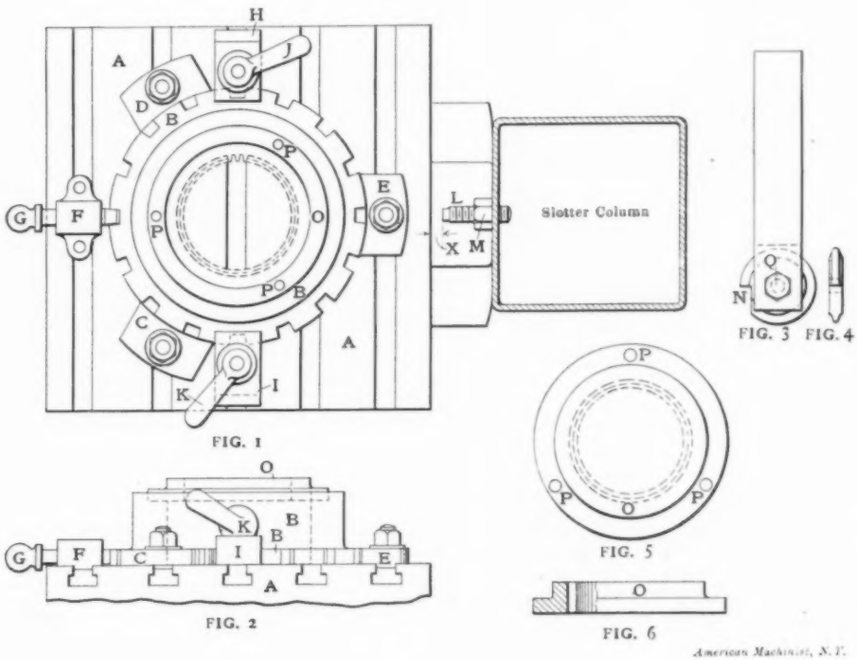
At *A* is the table of a small 4-inch stroke slotting machine to which the attachment is secured. At *B* is a gray-iron casting, faced up on the bottom and around the periphery, where the dividing notches are cut, as shown in Fig. 1. These divisions must, of course, correspond with the number of teeth required to be cut. It is also faced on the top, and recessed, as shown dotted in Fig. 2, to receive the work *O*, which should be previously turned on the bottom flange to be a good fit in the recess. At *C*, *D* and *E* are three locating dogs, which are secured to the slotter table by the three bolts shown. These three clamps are accurately located in position by two small, steel pegs ¼ inch diameter, which fit into small holes drilled into the table for the purpose. When clamped down they fit closely round *B*, and just allow it to be revolved by hand without any side play. *F* is a socket which holds a spring plunger *G*. This engages in the notches cut in *B*, and holds it securely while the work is being operated on.

The socket *F* is held in position by two ½-inch bolts passing through the two bolt holes provided for the purpose; *H* and *I* are two clamps, and *J* and *K* are the two handles for securing them by bolts to the dividing plate *B*. At *L* is an adjustable depth gage ⅝ inch diameter, with a case-hardened end. It is screwed into the slotter column, as shown, and locked by the nut *M*. The distance *X* between the case-hardened end of the screw and the inside machined edge of the slotter table is the depth of the teeth to be cut. The three holes in the gear *P* are for securing the latter in position in the machine of which it forms a part, and also act as clamping holes while the gear is being cut in the fixture; three set screws are screwed into three tapped holes in the recess in the top of *B*.

Fig. 3 shows the cutter bar and cutter for cutting the gears. The bar is milled out at the end for the gear cutter and it is gripped securely by the belt and lock nut *Q*, as shown. Fig. 4 shows the cutter only. This is, of course, turned the same profile as on an ordinary gear cutter of the same pitch, but instead of having teeth gashed in and backed off, it is simply gashed out, as shown. The cutting edge *N* is set straight across in a horizontal line.

The bar is gripped in the ram-tool box and the table set exactly central with it; that is, to bring the cutter dead central with the work to be cut. The cutter is then brought up to the work, and the ram set in motion. The work is fed up by the front traverse handle until the cutter just touches the blank. The machine is then stopped, and the depth gage *L* is adjusted and locked at the correct distance at *X*; a distance block is used for this operation, which is the exact width equal to the depth of tooth required to be cut. All being ready the spring plunger *G* is inserted in a notch in *B*, and a partial turn of the two locking handles *J* and *K* secures the lot. The operator then proceeds to cut the first tooth, and feeds the front screw handle up until the table comes in contact with the end of *L*; he then knows that the tooth is cut to correct depth without any further gaging. He withdraws the table until the cutter is clear of the blank, slackens *J* and *K*; a very slight movement only is necessary for this, due to everything being solid and free from spring. He then withdraws the plunger *G* and turns *B* around until he comes to the next dividing notch. He then inserts the spring plunger, locks *J* and *K*, and proceeds to cut the next tooth as before. All this is done in a very small amount of time. A youth operator soon becomes very expert at the job, and can turn out work with rapidity and accuracy.

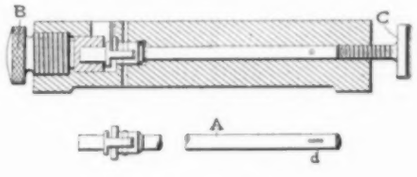
Coventry, England. C. Y. CLOBURN.



A SLOTTING ATTACHMENT FOR CUTTING INTERNAL GEARS

A Drill Jig

In the illustration the rod *A* is to have a number of holes *d* drilled in it. The screw *C* which acts as a stop for the rod



A DRILL JIG

is threaded so that its pitch is equal to the pitch of the holes *d*. After drilling the first hole the clamping screw *B* is slackened, *C* is turned one turn, *B* is tightened against the work, the next hole is drilled and so on until the drilling is finished. ISAAC MORGAN.

East Norwalk, Conn.

Turning Crank Pins on the Boring Mill

At the present time there are many small shops building gasolene motors that are not equipped with the special tools necessary to produce that class of work cheaply.

One of the problems has been to produce crank shafts with accurately turned pins at a moderate cost. This difficulty we have overcome by using the boring mill. In Fig. 1 will be seen a cast-iron fixture bolted to the platen of the mill. This fixture, which is shown in the drawing, Fig. 2, has four holes to accommodate the different sizes of shafts, and which are bored a distance equal to the offset of the crank shaft called for from the true center of the fixture. These holes are an easy fit for the work, and are deep enough to allow either end bearing of the shaft to enter the full length. On the bottom of the casting is a boss which is turned a close fit for the center hole in the boring-mill table. The four tapped holes at the top are for two threaded posts each of which carries a ¾ set screw. These posts are set opposite each other in either pair of the four tapped holes, and adjusted to accommodate the crank. The set screws bear against the extreme lower end of the crank pin, and do not interfere with the turning, but hold the pin firmly, and adjust it until the rough pin runs true. Set screws shown at the side of the fixture hold the end bearing from shifting.

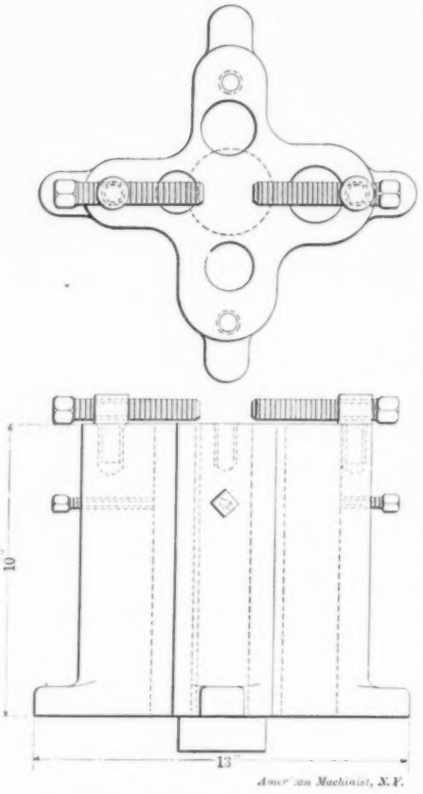


FIG. 2. FIXTURE FOR HOLDING CRANK SHAFTS

In Fig. 1 is shown a single-throw shaft with a heavy counterbalance, the sides of which come so near to each other that we could get a tool traverse of only ¾ of an inch, making it necessary to have a tool with three cutting points. The roughing tool can be seen just starting a chip; the finishing tool is in the next tool post. With care in setting and stoning, these tools give good satisfaction, the pin in this shaft being finished in about 30 minutes.

In the case of a double-throw crank shaft a pointer is placed against the side of the table, and two marks made 180 degrees apart. One mark on the table is brought to the pointer. Then the fixture is revolved until the hole in which the end bearing of the crank shaft is to be inserted is in such a position that a line drawn from the center of the fixture to the center of this hole would be parallel to the cross rail of the mill. The fixture is now ready to be firmly strapped to the table, and the crank shaft placed in its hole. Then a gage, the length of the space between the flat part of the cross rail of the mill and the center of the table, minus half the diameter of the rough pin is placed against the cross rail, and the pin that is not to be turned at this setting brought against it; this locates the pin about to be turned. After this pin is turned, the shaft is reversed, the other end bearing being placed in the fixture, the table revolved to bring the other mark to the pointer, and a gage equal to the distance between the cross rail and the center of the mill minus one-half the diameter of the turned pin placed

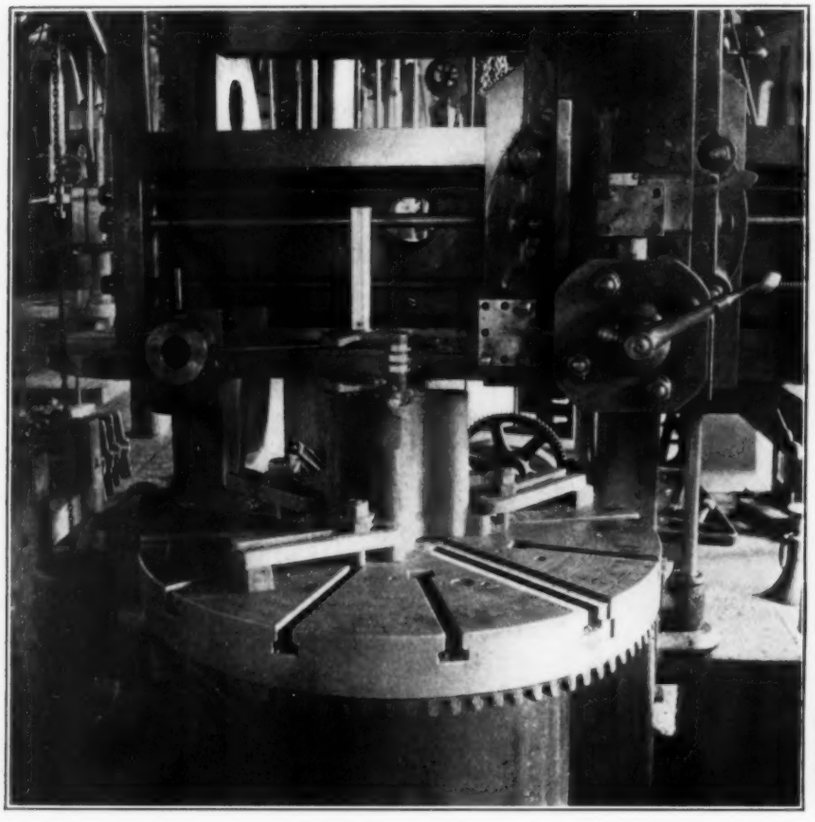


FIG. 1. TURNING A CRANK PIN IN THE BORING MILL

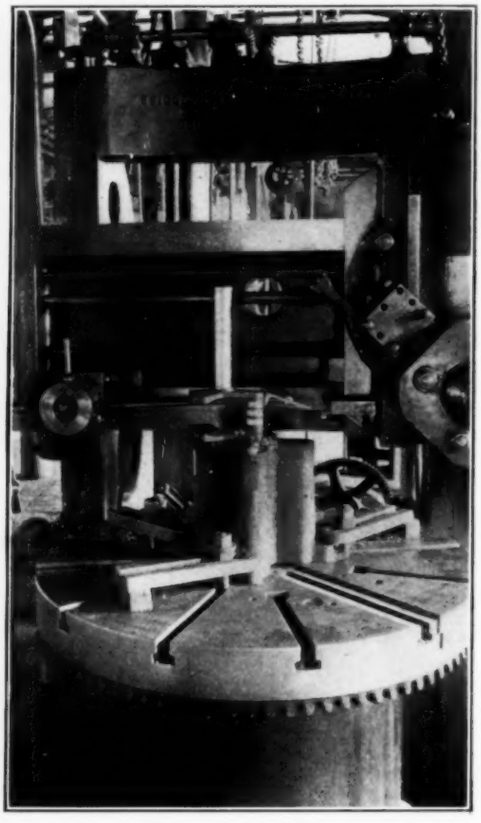


FIG. 3. ARRANGEMENT OF INDICATOR FOR SETTING BORING-MILL TOOL

against the rail and the turned pin brought to it, the shaft then being tightened with the set screws. This brings the pins opposite. The operation may look a little complicated but a little care makes the job a very simple one.

On the left of the cross rail is seen an adjustable stop and a long rod extending toward the head of the mill; on the end of this rod, in the rear, and a little above the turning tool is a Starrett indicator of the ordinary type. In Fig. 3 this is easily seen, the turret head being placed at an angle for this purpose. The two turning tools are set so that when they come to the proper depth of cut, the head comes in contact with the indicator, moving the pointer to a certain mark determined by the operator, this saving the caliper ing of the work after the first pin is machined. We have found that the pins are turned straight and round, generally coming within 0.001 of an inch, and making a first-class job.

The shafts were formerly finished on lathes by operators receiving a much smaller rate than the man on the mill, but the cost was higher, and the work very much inferior to that done on the boring mill.

It is perhaps unnecessary to add that only the crank pins are turned on the mill; the ends, and in the case of the double-throw shaft the middle bearing, are rough-turned on the lathe, and ground on a Landis grinder previous to turning the pin.

Waltham, Mass. A. M. L.

Grinding Spherical End Gages

Fig. 1 shows an arrangement for grinding the ends of end-measuring rods spherical. It was made to clamp on the slide of a cutter-grinding machine. The end-measuring gage to be ground is held in the holder *A* by the nurled-head screw shown; this holder is free to revolve on the screws *B* and *C* in the yoke *D*, which is also free to revolve in the body *E* so that when the end of the rod to be ground is brought into contact with the emery wheel it can be moved in any direction and made to pass over any point in a sphere, thus forming a spherical end, the radius of which is the distance from the center of the holder *A* to the end of the rod. This radius can, of course, be anything within the capacity of the device. Fig. 2 shows a holder for using end-measuring rods as a limit gage, and Fig 3 shows another convenient form of holder.

Leeds, England. MARK DALE.

Rig for Removing Bushings

Fig. 1 shows a simple rig for removing bushings, especially in cases similar to the one illustrated, when the end of the bushing and bottom of the chamber are perfectly square, and the bore of the housing only slightly larger than the internal diameter of the bushing. It also has the advantage of consisting, mainly, of parts used for clamping the work on the boring machine, or lathe; and therefore ready to hand in any workshop.

Referring to the line cut, *A* are two rectangular packing pieces or parallels, *B* an ordinary clamping plate, *C* a square-head bolt threaded far enough to allow the bushing to be withdrawn from the housing. *D* are two flat pieces of tool steel, shown separately in Fig. 2, beveled on the ends, one end being formed to an arc *R* equal to the arc of the internal diameter of the bushing. This can be quickly done on the emery-wheel or disk grinder. The several parts are assembled, and the bushing withdrawn by screwing up the nut *E* with a suitable wrench.

Of course, any piece of bar iron with a drilled hole will answer the purpose for *B*, and hardwood blocks might be used in place of the packing pieces *A*. When large bushings are to be removed, however, it would be an advantage if angle irons were used for this purpose securely clamped or bolted to the housing or part where the bushing is fixed in.

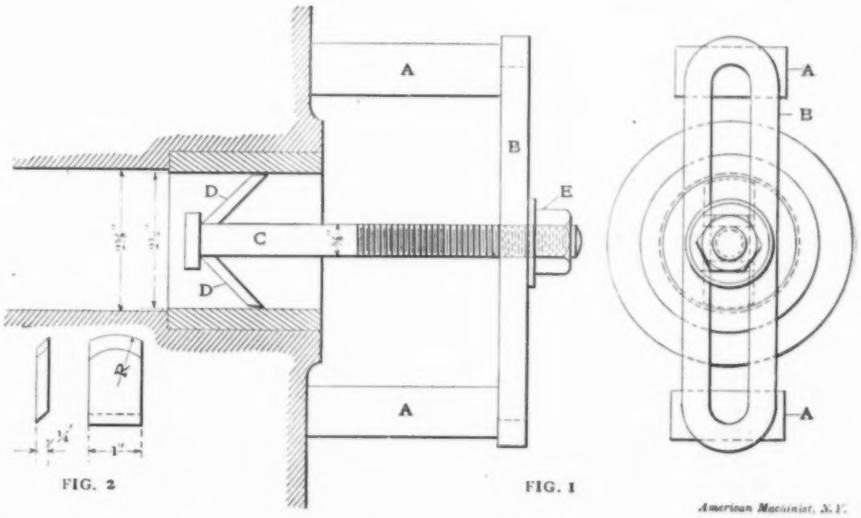


FIG. 2 FIG. 1

American Machinist, N.Y.

RIG FOR REMOVING BUSHINGS

This method is frequently resorted to in marine engineering repair shops, and will no doubt be found serviceable in many instances where no provision has otherwise been made for removing bushings when worn.

Glasgow, Scotland. O. SAVILLION.

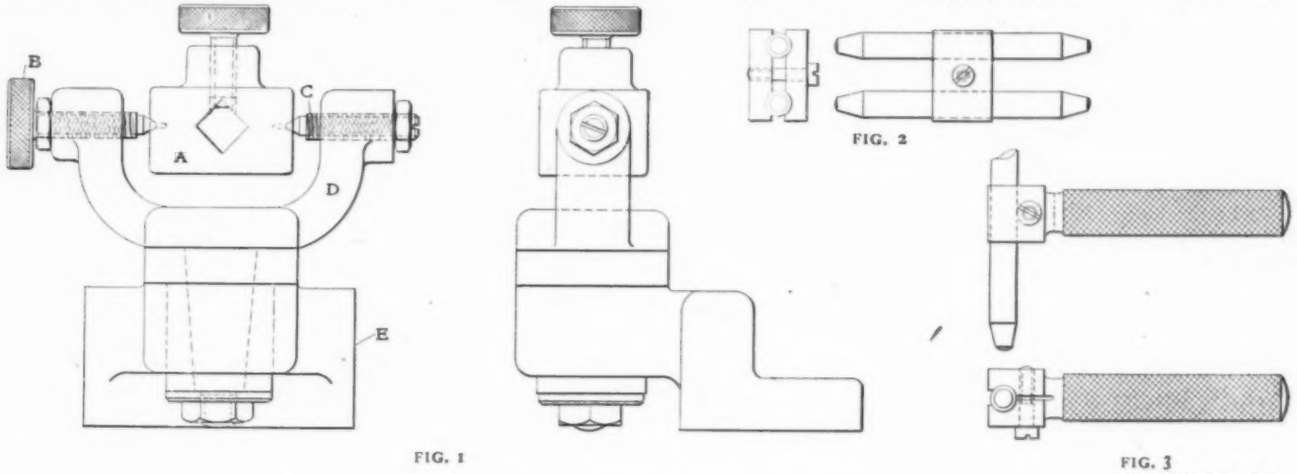


FIG. 1

FIG. 2

FIG. 3

American Machinist, N.Y.

GRINDING SPHERICAL END GAGES

An Indexing Device for the Drill Press

The accompanying sketches, Figs. 1 and 2, show a method of indexing on a multiple-spindle drill, when the number of holes to be drilled exceeds the number of drill spindles; the holes being arranged in a circle.

The ordinary way of drilling a piece of work under conditions as stated above, would be to drill part of the holes and then reset some of the drills to drill the remainder. This indexing device does away with the resetting of the drills, thereby saving considerable time when a large number of pieces of a kind are to be drilled.

The entire outfit can be easily and cheaply made, and when not needed can be taken from the machine and laid aside, allowing the machine to be used for more than this one class of work.

To construct this device we first take a chuck large enough to hold the piece of work and locate it on the table so that it is central with the drill arbor. It must also be held in the center so that the outside will revolve true about the center. As to the method of holding the chuck, this will depend entirely upon the design of the chuck. The one which I saw in operation was held as shown in Fig. 1.

A machine-steel stud, such as is shown, is threaded part of the way upon one end and screwed into the table. The other end is turned to a running fit in the chuck, which has previously been bored out. As most chucks have holes in the center it may only be necessary to true the hole up.

A steel lug *A*, Fig. 2, is screwed into the chuck and is drilled and reamed to receive the pin *B*. This pin is tapered off at the bottom to fit in the slot of the index plate. It is kept from turning by a small pin driven in the lug *A* and which fits into a slot milled in one side of *B*.

We now come to the piece upon which the accuracy and efficiency of the entire device depends, namely, the index plate *C*, Fig. 2. These index pieces can be most easily and economically made by taking a cast-iron ring of the section shown and finishing it in a lathe. It should be bored out slightly larger than the chuck so as to allow a small clearance between the two. It can now be taken to the milling machine and cut into small segments, one of which is to be the index plate for one series of holes. If the various series of holes are known beforehand, the plates may be indexed and notched on the milling machine before being cut apart. As each one is indexed it should be stamped with the number of holes it was made for.

These plates are so made that the included angle between the indexing slots is the same as the included angle between two of the holes to be drilled. To drill a piece of work with this device, we chuck the piece so that the holes will be arranged in a circle about the center of the chuck, using an ordinary flat ring templet for this purpose. This templet contains the exact number of holes to be drilled. We then set a drill at each alternate hole, first placing the pin *B* in slot *D*, as represented in the plan view in Fig. 2. In the case of an even number of holes we set the drills to drill one half the number; in the case of an uneven number we set them to drill the next whole number greater than one-half of the total number of holes. For illustration, suppose we wish to drill 24 holes on a 16-spindle drill. In this case

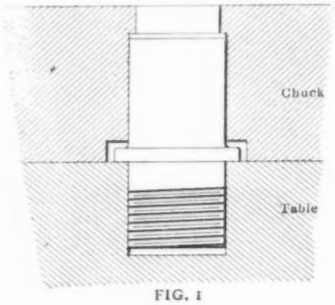


FIG. 1

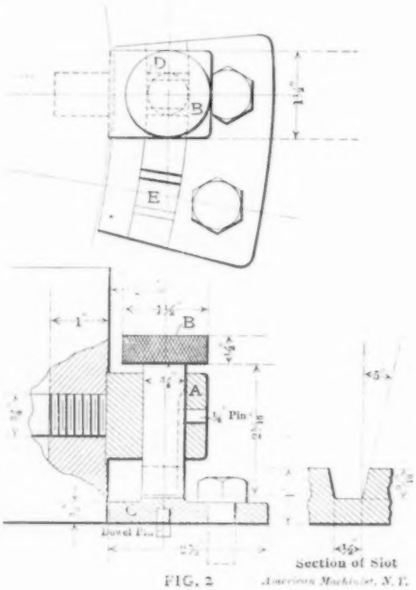


FIG. 2

INDEXING DEVICE FOR DRILL PRESS

we set 12 of the drills alternately while if we desired to drill 25 holes we would set 13 drills in the same way. After drilling these holes, and getting the work clear of the drills, we lift the pin *B* from slot *D*, revolve the chuck and put pin *B* in slot *E*.

If the index plate has been spaced correctly the drills will now be exactly midway between the holes previously drilled. There is no necessity of stopping the machine or resetting the drills.

When an uneven number of holes occurs, such as 25, and 13 drills are set, two of them will be consecutive, but this makes no difference, as on drilling the remaining 12 holes one of the drills merely runs into one of the holes made by its predecessor and "cuts wind."

Pittsburg, Penn. D. E. SINGER.

An Approximote Method for Laying Out the Circumference of a Circle on a Straight Line

According to mathematics, the circumference of a circle is equal to 3.1416 × diameter. It is a simple matter to lay out three times the diameter on a straight line, but the fraction 0.1416 × diameter, or 1/7 diameter gives more trouble. After drawing the given circle draw three radii including angles of 45 degrees, as shown by lines *O A*, *O B* and *O C* in the accompanying cut. Draw *C A* connecting the extremities of the two outside radii; that portion of the radius *O B* intercepted between the chord *A C* and the arc *A B C* will be the required fraction of the diameter.

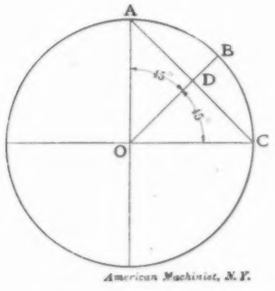


DIAGRAM ILLUSTRATING AN APPROXIMATE METHOD OF DEVELOPING THE CIRCUMFERENCE OF A CIRCLE

By taking the radius of the circle as 1 inch, the degree of approximation may be determined, for *O D* is the cosine of the angle *A O B*. Now, cos. 45 degrees = 0.7071; subtracting this from radius, 1 — 0.7071 = 0.2929; that is, *D B* = 0.2929. But this is in terms of the radius; dividing by two, changes to terms of the diameter, whence *D B* = 0.1465 × diameter. Subtracting 0.1416 from 0.1465 the error is found to be 0.0049 inch for a circle of 1 inch diameter.

Hartford, Conn. HOWARD C. WILEY.

"Coaster" Trucks in the Shop

At our shop there are errand boys who, besides running for tools, do light trucking. On one of the rear corners of the low trucks, they have tacked a strip of leather with hair stuffed under it, which acts as a knee rest, while the other leg pushes the truck along. The handle swings back to steer the truck. The floor being cement, rapid time is made besides giving the boy a ride.

Cleveland, Ohio. D. T. FLETCHER.

Discussion of the Previous Question

Letters from Our Readers Showing How Many Men of Many Minds Look upon Various Subjects Opened up in Previous Numbers

WE PAY FOR THESE ALSO

Producing Perfectly Flat Blanks

On page 753, Vol. 31, George Wilson has inquired how to flatten blanks used on clocks. The editor gave the real *cause* for having the blanks concaved or convexed, but not the *cure*. If the tools are properly made with proper fits on the dies and punches there is surely no reason why the blanks should not be perfectly flat.

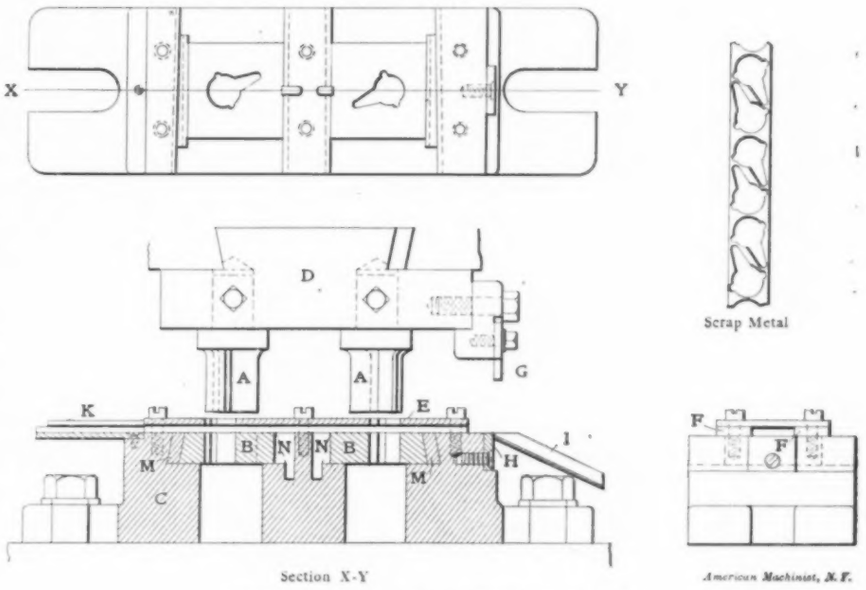
In the accompanying cut I have shown a set of gang tools in which *A A* are punches, *B B* the dies, and *C* the die bed. The punches are held into the punch holder by set screws and the dies which have a 10-degree angle on each side are held in place by the taper keys *M M* which drive from front to back. The taper on these keys is 1½ degrees.

When the dies are lined up with the punches they are marked and the key pins *N N* are put in in the same manner that the punch holder is located in the gate of a press. This is so that the dies may be removed and then replaced, and they will be in correct relation to the punches without trying them.

The metal is fed into the tools by means of an ordinary roll feed through the guides *K*. *E* is a stripper plate and *F F* are tool-steel guides with edges hardened and with elongated slots where the screens come for adjustment to suit the width of metal.

The punches descend, piercing the blanks, and they fall down through the bolster plate (not shown) and the bed of the press into a receptacle placed there for that purpose. As the scrap metal feeds along it is cut by means of two blades *G H*, and the scrap is carried away in the chute *I*. In this way no reel is required to wind the scrap metal.

As the plan view will show, the center line of the punches is set at about 25 degrees with the center line of the die bed, the *tail* end of the blanks toward each other. The strip of uncut metal will show that the blanks are pierced side by side, one a little forward of the other. By placing the punches this way a minimum amount of metal goes to scrap. A bridge of only a few thousandths between blanks is required.



PUNCH AND DIE FOR PRODUCING FLAT BLANKS

At the present time subpress tools are being used very extensively in the manufacture of watch and clock parts. The subpress keeps all the parts connected with a set of tools together and the life of the tools is lengthened by its use.

With some alterations this set of tools might be fitted to the special form of subpress described on page 461, Vol. 31, of the AMERICAN MACHINIST. The smaller blanks might well be blanked out in the ordinary type of subpress, a very good and clear use of which is described by F. A. Stanley on page 160, Vol. 31, where he describes their use at the Howard Watch Company's factory.

Waterbury, Conn. MILLS WRIGHT.

A Threading Tool

I have read a number of articles in the AMERICAN MACHINIST on thread cutting in the lathe with the compound rest set over 30 degrees. Fig. 1 shows a tool that I am using every day and I claim it is superior to any forged tool, as the cutting point stands up longer and cuts a smoother thread without any trouble.

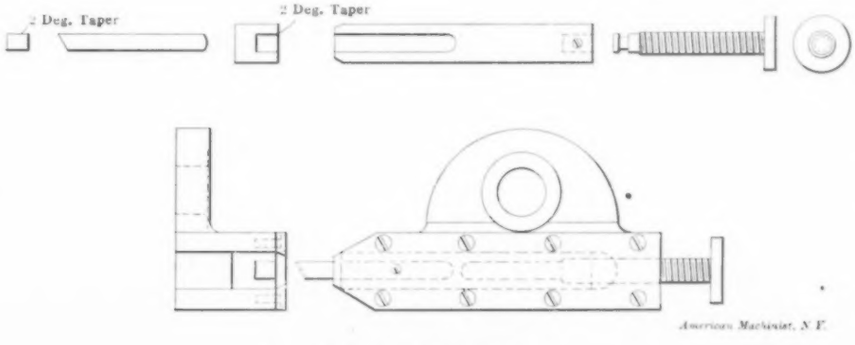


FIG. 1. THREAD TOOL

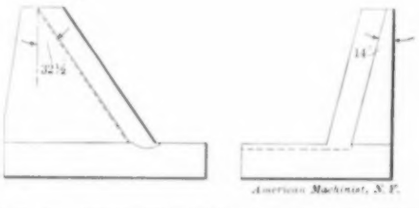


FIG. 2. GRINDING FIXTURE FOR THREAD TOOL

The sketch in Fig. 2 shows a small grinding fixture which I hold the thread tool in while sharpening under a surface emery wheel. No thread gage is required in this operation.

Orange, Mass. G. ALMQUIST.

Adjustable Face Plates and Master Plates for Accurate Tool Work

An adjustable face plate for accurate tool work was described at page 531; Vol. 31, Part 2. The accompanying sketches show another method of making an adjustable face plate.

In the first place it will be seen that by this method the cost of making master plates can be reduced considerably, because a greater range of work can be done on one size of adjustable face plate, whereas with the solid master plate a new one is required for each special job. The one shown in Fig. 1 can be set anywhere from ¾ inch to 4¼ inches by ten-thousandths if so desired. Fig. 2 shows a smaller plate for use in the bench lathe. The accuracy with which one of these plates may be set, depends entirely upon the skill of the mechanic. This idea of adjusting the plate in the manner shown is original with C. O. Gronberg who claims that it is as accurate a device as any solid master plate he has ever used. The holes must all be lapped the same size so that a standard plug will be a wringing fit in each hole. By inserting two plugs in the holes for the distance required, the eccentric, Fig. 1, can be adjusted so that by measuring across the outside of the two plugs and deducting the diameter of one of them the exact center distance will be obtained. Now a plug center inserted in the lathe spindle is turned to fit snugly in the hole in the master plate, then the plate is wrung on the plug and clamped against the face plate as shown in Fig. 1. The work to be bored should have one hole bored and lapped to size so a plug can be inserted in it and in the hole in the eccentric which has been set the correct distance from the center; clamps, which are not shown in the sketch, are used to hold the work in position on the plate. Proceed as usual to bore and finish the other hole.

Elgin, Ill. A. J. DeLille.

Drill Jigs for Magnet Frames

At page 916, Vol. 31, Part 2, you describe "An Universal Vise—System Wolfsensberger." In looking over my index

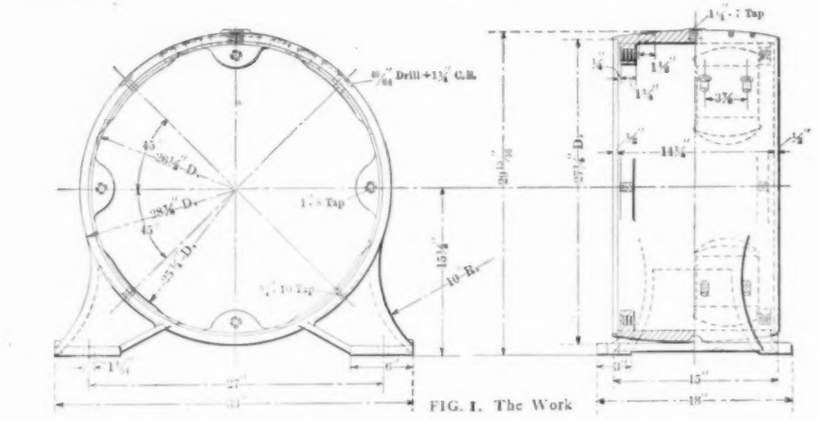


FIG. 1. The Work

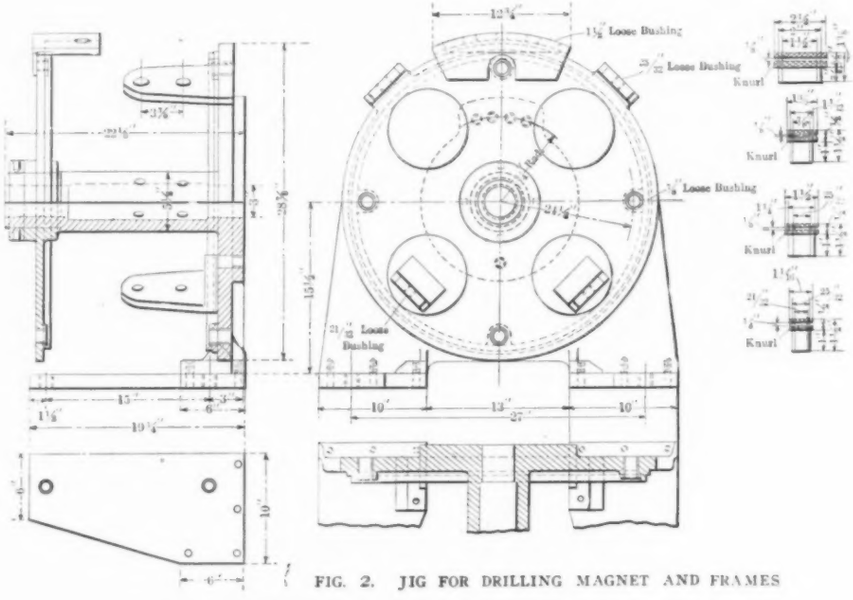


FIG. 2. JIG FOR DRILLING MAGNET AND FRAMES

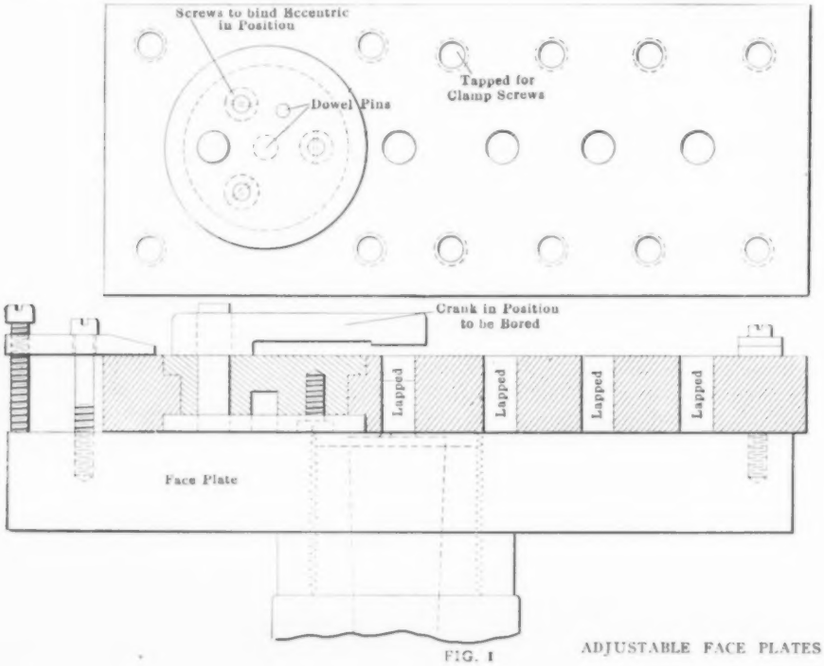


FIG. 1

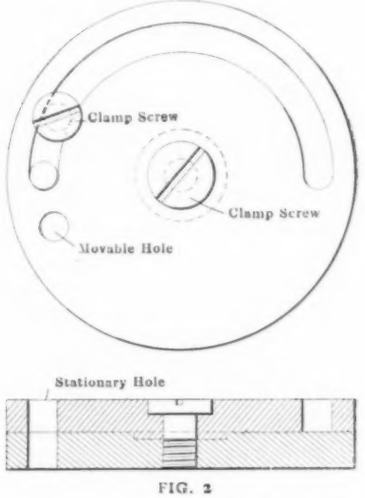


FIG. 2

American Machinist, N.Y.

ADJUSTABLE FACE PLATES AND MASTER PLATES

card headed "Drilling Jig," I note that after reading an article signed "Beck" published at page 601, Vol. 28, Part 1, I prepared an article, but for one reason or another did not send it, though I thought my system to be somewhat new. Of course, the tools shown in the accompanying drawings are not vises but drilling jigs. I have thought that some of your readers might be interested, and this time venture to send you these drawings. The

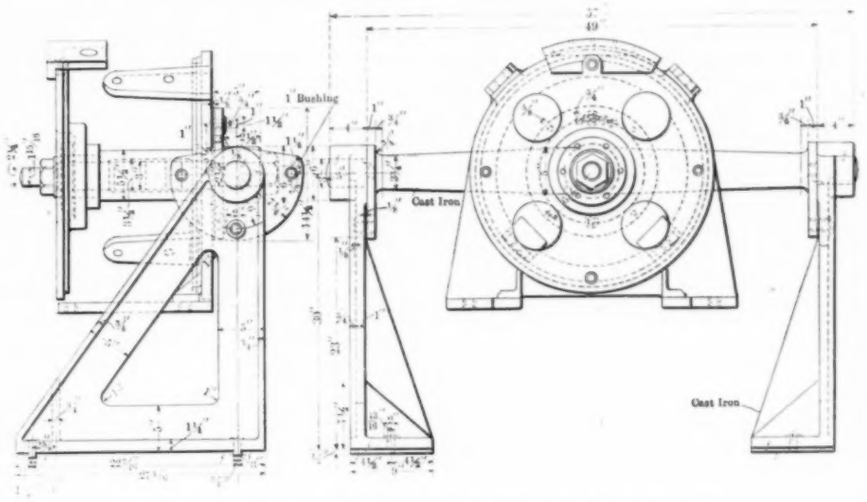


FIG. 3. SUPPORTS FOR BOX JIG FOR DRILLING MAGNET FRAMES

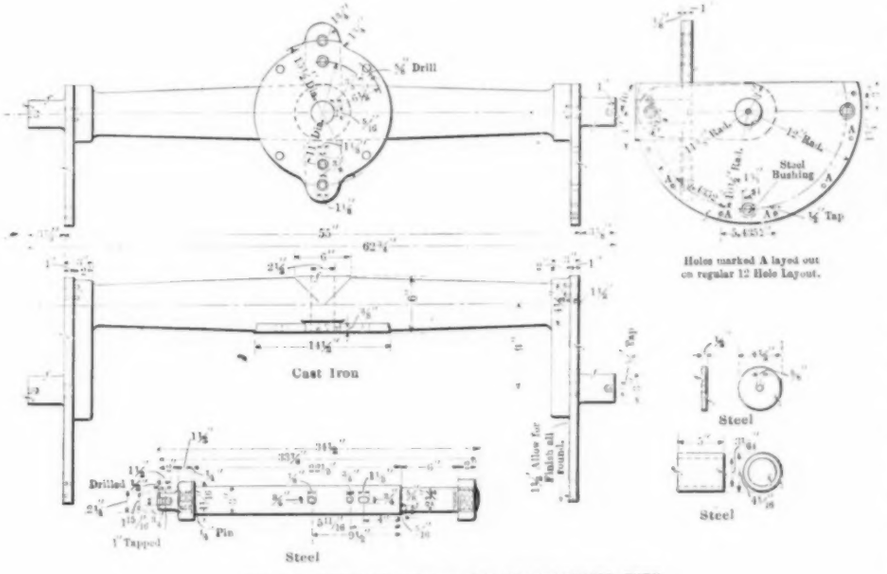


FIG. 4. OFF-SET SHAFT FOR SUPPORTING JIGS

jigs were designed for electric motor work, but can be used for other kinds of machinery.

Fig. 1 shows the piece to be drilled; Fig. 2 shows one of the box jigs; Fig. 3 is a jig on its shaft and supports; Fig. 4 is an eccentric shaft made to be used on the same stands, but for heavier work needing to be balanced for ease of handling. I have since designed several of these jigs, some for pieces weighing up to fifteen hundred pounds and all have proved most satisfactory.

Peterborough, Ont. J. A. G. GOULET.

An Anti-Chattering Device

Referring to the anti-chattering device on page 968, would it not have been better to find out the cause of the chatter and stop it rather than adopt a method which increases power consumption? A boy who turns collars and short shafts had some chattering trouble the other day. He noticed that while the chatter was going on his lathe face plate and dog were hammering each other; it struck him at once that this was a similar action to that of paring rubber with a pocket knife which resulted in a series of stops and starts or jerky cutting. He knew that when his job stopped and his cut was on it left a mark, hence the marks of chattering; this stopping and starting were caused, he thought, by the lack of rigidity in the material.

He pulled off his face plate and put on a jaw chuck, gripping the shaft which was still on the centers, by the jaws, thus making the job solid with the lathe spindle; he then shoved on his feed and put his belt on another quicker cone speed and tested with a cutting speed of over 90 feet per minute with a finishing tool 1 inch wide. Looking at the work with a powerful glass there was not a jarring mark to be seen. Under the same conditions respecting the tool but at a much slower speed and with a face plate with a dog on the shaft the marks were almost 0.005 inch deep and about 1/16 out of parallel with the axis of the shaft in 1 inch.

How often lathe makers are blamed for cases like the above when the real trouble is a lack of support for the job.

Manchester, England. CADILLAC.

How It Has Paid Another Contributor to Write

I was interested by what "C" had to say at page 237 about his friend who rose through his efforts at writing, and as I am a great believer in actual concrete results rather than theory about such things I will set down an experience of my own along these lines:

Several years ago I began in a small way to send in short articles to the AMERICAN MACHINIST and other papers and in about 75 cases out of 100 was rewarded for my efforts by a cheque; this stimulated my efforts until I began to break into a full page now and again. About that time I was trying to land a position with a large firm, in which any skill I possessed as a writer would be called into full play. Absolutely my only credentials of that sort consisted of a tabulated list of what had been printed, in the several journals, from my pen.

The last afternoon that I laid off from the tool room where I was employed to look after the new job, the jade luck was evidently with me, for as I entered the manager's office—after an hour's wait—I espied on his desk the latest issue of a mechanical periodical in which I was morally certain (although I had not seen it previously) that there were about 2½ pages above my name. Our talk was short and to the point. Before he could speak I said, "Excuse me, but have you looked through that copy yet?"—pointing to the periodical. "Yes," he answered. "Well what do you think of the article on" (stating the subject)?

"Oh!" he replied, "it is O. K.; seems to get after the main point, but what has that to do with you?" "Well!" I said, "I wrote that as you will see by a glance at the name, and I can write more stuff like it for my employer if he wants it."

"I guess we will give you a trial; can you come in in the morning at 8:30? You can take that desk in the corner. Good-day."

The salary attached was about what I was then earning multiplied by two.

Ottawa, Can. D.

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March 4	33,500
March 11	19,250
March 18	19,250

This paper reaches 33,500 *separate readers each month and* 19,250 *each week.*

None sent free regularly, no returns from news companies, no back numbers. Figures are live, net circulation.

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Is the Metric Agitation on Again?

Along with our readers we had hoped that the French calm which appeared to have settled over the agitation for the adoption of the metric system would prove of long duration, if not permanent, but there are indications that in this we are to be disappointed. Among these is the appearance of a new monthly publication —the *Journal of Weights and Measures,* published at Troy, N. Y.—which bears all the indications of being under the inspiration of Doctor Stratton, the Director of the National Bureau of Standards. The journal is not primarily a metric organ, the most of its contents having no relation to the metric system, but nevertheless, it serves up the metric gospel on the side, and in this way, perhaps, accomplishes more for this cause than if it were made more prominently its main object. The magazine is, in fact, a very shrewd piece of metric campaigning. It will, we judge, circulate largely among the official sealers of weights and measures, for whom it may find an abundance of interesting and useful material, and thus secure their subscriptions and attention. At the same time, by constantly preaching the metric gospel, it may readily make of these sealers of weights and measures very effective missionaries among the merchants and others with whom they come in contact. The journal is already the official organ of five State sealers' associations.

More important than this is the handing in of a report by a special committee of the American Society of Civil Engineers, in which we have a restatement of the reasons for the adoption of the system which have done duty for more than a century, and which are conclusive or absurd, according to the viewpoint of the individual reader.

To a considerable extent this document is a report of the present status of the system in the United States which, rendered otherwise, means that it is a report of the progress of Doctor Stratton in bringing about the adoption of the system in various departments of Government work, progress which is sufficient to give notice to those who oppose the system that Doctor Stratton occupies a position of influence where he can accomplish much in introducing the system into the public business of the country without congressional action or sanction. Much has been said of this before, but we have seen no such striking illustrations of the success of his efforts as those given in this report.

That the report is thoroughly prometric may be gathered from the legislation which it recommends. It advises first, that the States pass laws requiring the teaching of the metric system in all public and private schools of every grade, and that "the subject should be taught as prescribed and regulated by the National Bureau of Standards at Washington, D. C."

As regards national legislation the report recommends that "the Congress should assert its authority in clear and unmistakable language that, from and after a certain date (allowing not over five years from date of passage) the international metric system of weights and measures shall be the only lawful standard throughout the United States, its Territories and possessions, and that failure to comply with this act shall be punishable by fine, or imprisonment, or both, as the court may direct."

The Specification of Constructive Materials in Machine Tool Practice

The common method followed by American machine-tool builders in explaining to their prospective customers the quality of the steel used for various purposes in their products is to specify the carbon content.

What the user desires to know is, of course, the mechanical properties of the materials thus specified, a statement of the chemical composition being useful to him only as an index of the mechanical properties. The specification of the carbon percentage has become so common in this country that the average American instinctively translates it into an equivalent of mechanical properties. We do not mean by this that he translates a statement that a given piece of steel contains a certain number of points of carbon into a statement of strength and ductility, expressed in exact figures, but nevertheless, he unquestionably does translate it into a general idea of strength and ductility sufficient to indicate whether or not the material is appropriate for the purpose.

We are just in receipt of the following letter, pointing out that this practice is not satisfactory among Europeans who are in the habit of specifying the steel used for any purpose by a statement of its mechanical properties and not of its chemical composition. The letter and its signature speak for themselves:

"The object of this letter is to draw your attention to a very interesting question, which I think deserves being thoroughly studied and discussed in the AMERICAN MACHINIST. It is as follows:

"In the United States the degree of toughness of steel is commonly defined by its content of carbon, without mentioning the other minerals as manganese, nickel, phosphorus, etc., which likewise are contained in it.

"In France one generally defines the toughness of steel by its tensile strength and the proportional lengthening the steel admits before breaking.

"By means of long and special studies, confirmed by laboratory experiences under the supervision of an engineer, expert in

chemistry and metallurgy, it was not difficult to prove that correlation exists between the above two systems, and that it must be possible to establish comparative tables, giving the corresponding denominations in each.

"I think the above subject will interest you sufficiently to be treated in your paper, and in the meantime would ask you to kindly point out to me where I could obtain the necessary information for my own use.

"You will understand that when selling American machinery it is of the greatest importance in order to convince customers of its efficiency, that we should be able to exactly point out to them what work can be accomplished when handling different materials. To do this the data given in American catalogs are, however, absolutely useless, being incomprehensible to French users, and thus can only be of service to me when I am in a position to translate them into the French system."

ALFRED H. SCHUTTE,
MAX BUHLING,
Manager.

Paris, France.

We quite agree with our correspondent that this is a subject which deserves discussion in our columns, and moreover, a change of practice in machine-tool catalog literature. The American method of specification, while an easy one, is undoubtedly roundabout, as it does not give what the purchaser wants, but instead, only general data from which he can obtain what he wants by an inferential process of reasoning to which the European buyer is not accustomed.

It is needless to say that we have sent the necessary information to our correspondent, but we believe a change in the customary practice would be advantageous to all concerned.

Cleveland's Home Products Exhibition

Announcement is made of an industrial exposition to be held in Cleveland, June 7 to 19, with a view to exploiting the products of the city. The output of Cleveland factories is remarkably varied and large anticipations are already being formed regarding the magnitude and scope of the exhibition. Central Armory has been selected as the largest available hall in the city, but as it is not expected to be sufficient, a large temporary exhibition building will be erected diagonally across the street from the armory. The floor area of these halls will exceed that of the Madison Square Garden of New York City.

Address Wanted

Herbert Allison, some years with the American Bicycle Company, at Westfield, Mass., and New York City, is requested to communicate with John H. Boyd, care AMERICAN MACHINIST, New York City.

A Remarkable Advertisement

All who read the papers nowadays—and who don't?—must have remarked the increasing intelligent use of advertising space for many other purposes than the sale of things.

The railroads are using advertisements to put their cases as to franchise rights, rates of suburban fare, and needed improvements, the rights to which must be secured from the people themselves by direct vote or through their commissions.

The larger *buyers* of things are advertising their wants and thus securing touch with every worth-while maker of the things they need.

On another page is an advertisement of a big builder of automobiles soliciting bids on hundreds of thousands of dollars worth of material and parts made by our readers.

We venture to predict that more than one concern will secure some very desirable business through this announcement, and that the buying concerns will save themselves much money and more annoyance and delays in the placing of these splendid orders.

This is the beginning of a new era in the art of advertising. When business houses make known their wants in this way they take no chances of buying blindly only to discover later that something else would have been better.

New Publications

BOILERS. By Hubert E. Collins. Hill Publishing Company, New York. Cloth; 196 pages, 4½x7 inches; illustrated. Price, $1.

This book, which is one of the *Power* handbook series and was compiled largely from *Power and The Engineer*, starts with a description of what goes on in a boiler as seen by watching a glass model of a water-tube type. Then follow simple talks on the Efficiency of Riveted Joints; the Bursting Strength of Boilers; the Bracing of Horizontal Tubular Boilers; Directions for Calculating the Strength of Riveted Joints and for Finding the Area to be Braced in Boiler Heads; a Graphical Determination of Boiler Dimensions; the Safety Valve; Horsepower of Boilers; Boiler Appliances; Care and Management of Boilers; Setting Return-Tubular Boilers; Renewing Boiler Tubes; Use of Wood; Boiler Rules; and Mechanical Tube Cleaners.

THE TEMPERATURE-ENTROPY DIAGRAM. By Charles W. Berry. Published by John Wiley & Sons, New York, 1908. Cloth; 314 pages, 5x7½ inches; 109 illustrations. Price, $2.

This is the second edition of Professor Berry's excellent work, and a mere comparison of bulk would suffice to indicate extensive revision; in the present edition there are more than twice the number of pages in the first edition. The chapter on the flow of fluids has been thoroughly revised, a graphical method of projection from the pressure-volume plane to the temperature-entropy plane for perfect gases has been worked out and its application illustrated in two chapters on hot-air and gas engines; a chapter on the thermodynamics of gas and vapor mixtures has been added, and the various factors affecting the efficiency of actual gas-engine and steam-engine cylinders are discussed. For the information of those unfamiliar with the first edition it may be stated that the work is chiefly mathematical in character; the discussions are, however, correspondingly accurate and complete.

Edmund L. Zalinski

Major Edmund L. Zalinski, U. S. Army retired, whose name was prominently connected with the development of the pneumatic dynamite gun of twenty years ago, to which he was detailed by the army authorities, died at the New York Hospital, March 10. He was born in Kurnich, Prussian Poland, on December 14, 1849, and came to this country with his parents when he was four years old. The family settled at Seneca Falls, N. Y., and Major Zalinski was educated at the schools in that place, and at the Syracuse High School, where he studied from 1861 to 1863. In the following year he entered the army as a volunteer aid-de-camp on the staff of Gen. Nelson A. Miles, and served until February, 1865, when he was appointed a second lieutenant in the Second New York Artillery. He was honorably mustered out of the volunteer service on September 29, 1865.

In the next year he was appointed a second lieutenant in the Fifth Artillery in the regular army, and he was promoted to first lieutenant in 1867 and captain in 1887, and was retired on account of disability in 1894. Ten years later he received the rank of major for civil war service.

From 1872 until 1876 he was professor of military science in the Massachusetts Institute of Technology, and in 1880 he was graduated from the Artillery School at Fort Monroe and the Willets Point School of Submarine Mining. Most of Major Zalinski's time had been devoted to the development of the pneumatic dynamite gun, a weapon throwing a projectile weighing 1000 pounds, charged with 500 pounds of high explosives. He had also invented an intrenching tool, a ramrod bayonet, and a telescopic sight for artillery, and a system of range and position finding for seacoast artillery firing. He traveled under orders in Europe in 1889 and 1890 to obtain military information. In this city he was a member of the Century, Union League, Lotos, and Engineers' clubs, and his home was at No 136 East Seventeenth street.

Hand Chipping—A Textile Machinery Making Operation

By Clinton Alvord

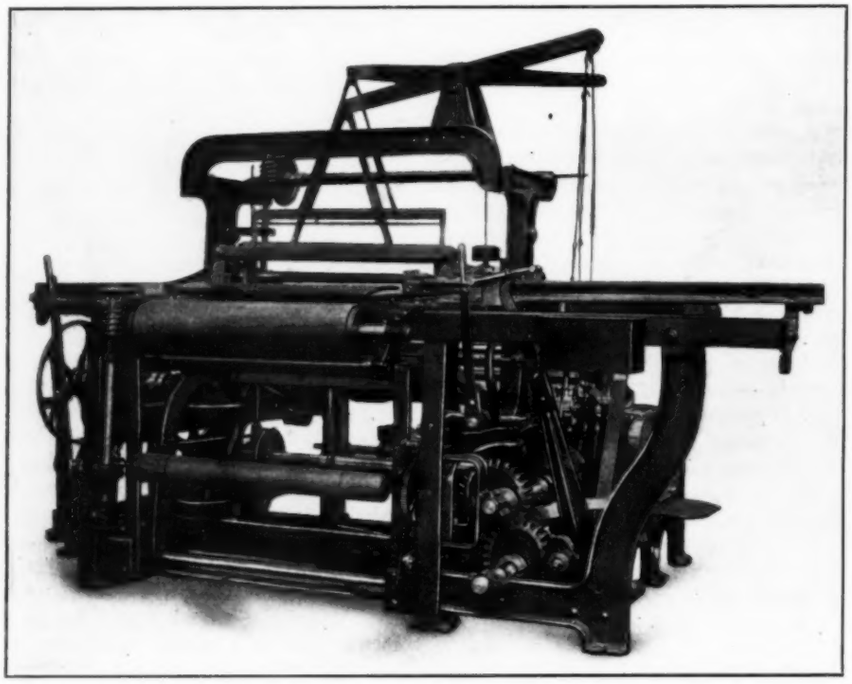
A well known manufacturer of machine tools told me that the better one made machinery, that is, the closer it was to being interchangeable, the cheaper it could be manufactured.

Loom builders have not worked on this theory in the past, although modern tendencies have begun to affect them somewhat. The hammer, cold chisel, and coarse file in the hands of a workman do all the fitting for "setting-up." A good "setter-up" of looms is in a special trade as the loom is a machine which for the past hundred years has not been an instrument of precision; in fact some makers insist that it cannot be such and at the same time weave good cloth. This, however, is a disputed point and there are those who work on the theory that the better a loom is built the more perfect will be its product.

The work of some of these "setters-up" is remarkable. The cut illustrates a loom for weaving a pile carpet, a "tap loom" as it is known in the trade. This photograph shows plainly the work done by hammer and chisel. There is absolutely nothing done on the loom sides, or frames, by planer or milling machine. The frame of the loom, which includes the side frames and various girts, is assembled directly from the casting-cleaning room by means of hammer and chisel; and the structure is required to be substantially square. The side frames are of the web and double-rib style and the ends of the girts are equipped with chipping bars that are bedded to the web of the side frames by chisel and file; an accidental swell, or lump on the loom side calls for a corresponding hand-fitted recess in the chipping bar of a girt. There are suitable elongated holes in the side frames and similar holes cast in the feet of the girts to cross the slots in the side frames and thus insure a free passage for the bolts. If the holes have floated away in casting, or if the cores have been set poorly in the feet of the girts then the "setter-up" must chip a hole for the bolt, which has a button head and is square under the head, but the elongated holes are supposed to be large enough to avoid any chipping there.

Assembling the frame is rough work and requires a strong man, for often there is 5/16 inch to be removed from the ends of some of the girts when the iron has not shrunk standard, and in such cases the chipping bars must be removed and the workman cut away into the solid foot. The work must be done so that the side frame will not spring away from one of the girt feet, when the bolts are loosened up, more than one-sixteenth of an inch, and as previously stated the frame must be practically square. Sometimes the girts are machine-squared to length and then matched to the rough loom sides.

The outside cam frame, showing in the picture on the right-hand side of the loom, is spaced from and attached to the side frame by three posts that are chipped into place; and the pulley frame on the left-hand side of the machine is attached in the same way. These outside frames are supplied with feet for attaching them to the floor, for most looms are designed to be a part of the building, and the floor is a portion of the machine. The frame is leveled up with a spirit level placed on the rough castings, and if the loom is not set at about the same level in the mill there is likely to be a hot box somewhere. Each foot must be packed, for it is easy to raise one corner without disturbing any of the other three. I know of but one loom-building concern that makes a heavy machine which does not have to be bolted to the floor, and in which the floor of the mill is not intended to be a portion of the loom. The loom illustrated will weigh as much as 5200 pounds and any "heavy loom" would weigh as much as 2200 pounds.



A REPRESENTATIVE LOOM WITH HAND-CHIPPED FRAME AND BOXES

This carpet loom has 20 pairs of boxes, or bearings, holding 20 distinct shafts, and all these bearings are chipped into place by hand. The workmen use hand and not air hammers. Shafts are fitted to bearings with a running fit of about 0.003 inch play and the boxes are lined up in good shape so the shafts revolve freely. Some mills prefer a loose running fit as they desire a new loom to start off as freely as though it had been running a year.

It requires an expert fitter to line up the boxes of the two shafts carrying the eccentric gears shown at the front of the picture. The top shaft must intersect the center of one of the principal longitudinal shafts, for it is driven therefrom by bevel gears; must be at right angles to that shaft and level and parallel to the lower crank shaft carrying the bottom eccentric gear. The bearings are not jig drilled and, therefore, may easily vary 3/16 of an inch from the feet, and the workman must make them come into place. Small brackets and bearings have chip bars ⅛ inch high, while large castings may have them as large as ¼ inch. Now and then an important box is doweled by straight pins, but the pins are seldom put through the chipping bars and therefore they extend across an air space of ⅛ inch or more which greatly reduces their efficiency. All gears have cast teeth, except possibly the worm and gear shown at the left of the half-tone.

An expert can line up and attach eight pairs of single-footed boxes in 10 hours when he gets his hand in, at a labor cost of but 15½c. per box. The boxes for the eccentric gear shaft above mentioned have double feet and therefore take longer to fit, but most loom boxes are similar to the outside one on the lower crank shaft above described, and it is a fair sample of the work required for it is shown as bedded down onto the rib of the supporting bracket.

The ogee curve in the brace for the breast beam showing in the extreme front of the photograph is supposed to be graceful. The "powers that be" can see no beauty in a straight line even under such conditions and that brace is supposed to contain the "curve of beauty."

A loom like this will weave 80 to 90 yards of tap carpet, that is, tapestry brussels, in 10 hours with one operator per loom.

New Tools and Machine Shop Appliances

Showing New Ideas in Machine Shop Equipment That Make it Possible To Do Better Work at a Reduced Cost

THE LATEST INFORMATION

Tabor Jarring and Hinged Molding Machine

This machine combines the Tabor jarring and their hinged machine in one. The jarring saves nearly all of the ramming time and the hinged machine saves the pattern-drawing and finishing time, so that the combination of the two leaves very little for the molder to do besides shoveling sand and carrying away the finished mold.

The machine shown was built for and is now operated by the Standard Steel Company, at Burnham, Penn. It was designed to produce from 50 to 75 complete molds of car-wheel centers per day of 10 hours with three men who formerly put up but eight molds by hand. The machine is intended for car-wheel centers, handling flasks from 36 to 44 inches inside diameter. It can also be used on a great variety of work which does not exceed in weight the capacity of the roll-over cylinder, which would be a net weight of 2500 pounds, including flask pattern, bottom board and sand. The complete machine weighs 30,000 pounds and is set in a pit with the pattern-plate level with the floor, occupying a space of 7x12½ feet.

The machine consists of an anvil, in the center of which a 13-inch jarring machine with a 42x48-inch table is placed. At one end of the anvil a 20-inch roll-over cylinder is mounted, which carries a hinged frame. The arms of this are made to come down clear of the jarring table on either side of its shorter dimension. The arms carry the pattern plate, which is centered on the table by dowel pins, and when the pattern plate has been lowered upon the jarring table, the arms of the hinged frame drop away from it. Thus, there is no connection whatever between the jarring table and the roll-over mechanism during the process of jar-ramming.

After the mold has been jar-rammed to the proper density and the bottom board clamped on the flask, pressure is admitted to the roll-over cylinder which brings the arms of the hinged frame up in contact with the pattern plate. During this movement the dowel pins in the hinged frame enter bushed holes in the pattern plate, thus doweling the pattern plate to the hinged frame before lifting the pattern plate off of the dowel pins in the table of the jarring machine. This movement lifts the pattern plate with the flask off the dowel pins and clear of the table, and this continues until the end of the vertical movement is reached and the roll-over movement begins. From this point the pattern plate is securely locked automatically to the hinged frame, so that when rolled over, it remains suspended with the flask and bottom board clamped to it.

These machines are provided with a speed regulator which automatically increases the speed of the roll-over cylinder from the beginning to the end of the roll-over movement in both directions. This assures a rapid transfer of the mold from the jarring table to the equalizing table. The speed of the roll-over cylinder on the downward movement in either direction, is choked gradually so as to be absolutely free from shock.

The equalizing table is an automatic leveling device by which the mold is set without reference to the pattern plate, no matter how crooked the bottom board may be; and absolute stability is secured by supporting the bottom board on three points only. As soon as the weight of the mold comes upon the leveling cradle it locks and holds it in a set position, while the pattern is drawn, as shown in Fig. 2.

The device employed to lock the pattern plate to the hinged frame is provided with an automatic safety attachment to prevent the mold from being rolled over unless the pattern plate is securely locked to the hinged frame.

During the return of the hinged frame to its position on the jarring machine, it is automatically unlocked from the pattern plate, so that when the latter settles

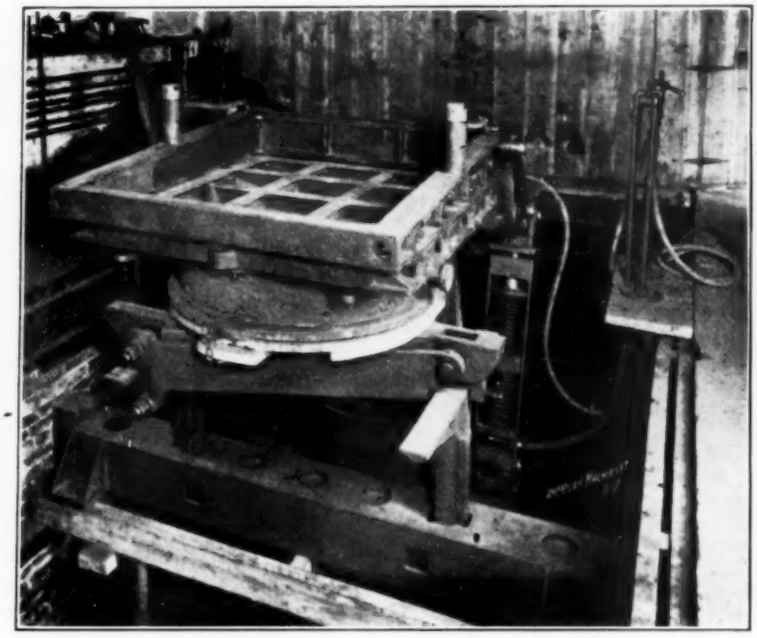


FIG. 1. MACHINE WITH FLASK RESTING ON TABLE AFTER RAMMING

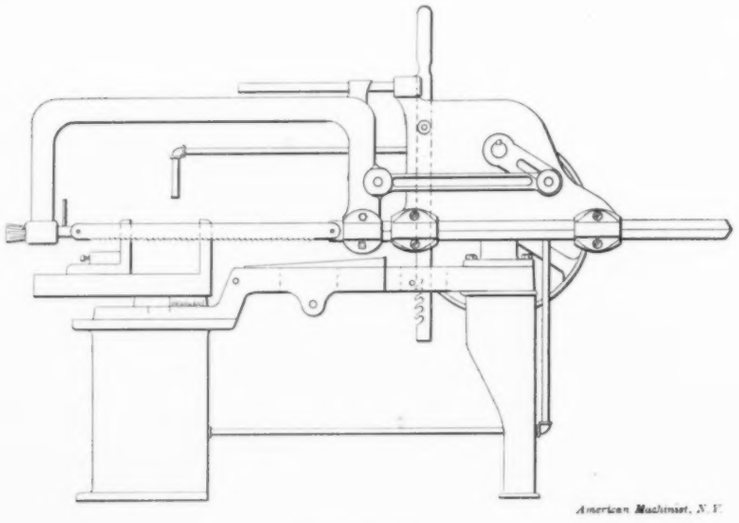
FIG. 2. PATTERN DRAWN FROM MOLD AND MOVING TO ITS LOCATION ON JARRING MACHINE

on the dowel pins in the jarring table, the former is free to drop clear of the pattern plate to its proper position.

A pattern draft of 18 inches has been provided for, thus making the machine available for deep work of any kind suitable for jar-ramming. With this type of machine it is possible to draw a pattern having the least possible amount of draft; in fact, with the use of a vibrator it is possible to draw patterns of considerable depth without draft. It is built by the Tabor Manufacturing Company, Philadelphia, Penn.

Robertson's Power Hacksaw

The saw shown has several features which interest the users of such machines. The bed is lowered at the outer end so as to secure a better cutting angle when starting the cut on a piece reaching its full capacity of 8x8 inches. The saw is relieved on the back stroke, has a gravity feed which can be increased as the saw dulls. The vise has a swivel jaw, graduated to 45 degrees. The stroke can be varied from 4 to 9 inches. The vertical handle back of the swing carriage is for holding the saw in any desired position while putting in new work, the notches allowing for different hights. The frame can also be raised into a vertical position when desired. It handles blades from 14 to 17 inches long and is run from 60 to 70 strokes per minute. The leg at the left forms a tank from which a lubricant can be pumped to the saw through the piping shown. This is made in three sizes by the Robertson Drill and Tool Company, Buffalo, N. Y.



POWER HACKSAW

The Rice Roller Relief Bearings

This is something decidedly novel in the bearing line, differing both in construction and application from the usual methods employed and while not supplanting the regular roller or ball bearing in their legitimate field has the advantage of being applicable to any overloaded bearing in a very few minutes, such as at noon or night.

There are many places where engineers hesitate to use the more delicate types of bearing and stick to the old plain bearing as being better adapted to the conditions that exist and it is here these relief or auxiliary bearings come into play. It is their purpose to relieve the friction load and render the standard bearing more efficient.

These bearings can be applied at either side of an engine flywheel, and by the use of calibrated springs can be made to sustain the weight of the flywheel, which would greatly relieve the duty of the journals as commonly applied and where few, if any, engineers would admit that it would be safe to apply roller bearings to the main journals of the engine proper. They can be applied to any idler having heavy duty at either side of a main driving pulley, carrying both the weight of the pulley and opposing the stresses of the belt; and are especially valuable on engine shafts where an electric generator exists beside the flywheel; both of which place a heavy duty on the bearings of an engine thus equipped.

The bearings can also be placed progressively, trailing from a central power station outwardly to the shafts of lesser duty and at each important point, i.e., where a subdrive exists and as far as may seem feasible in any given case.

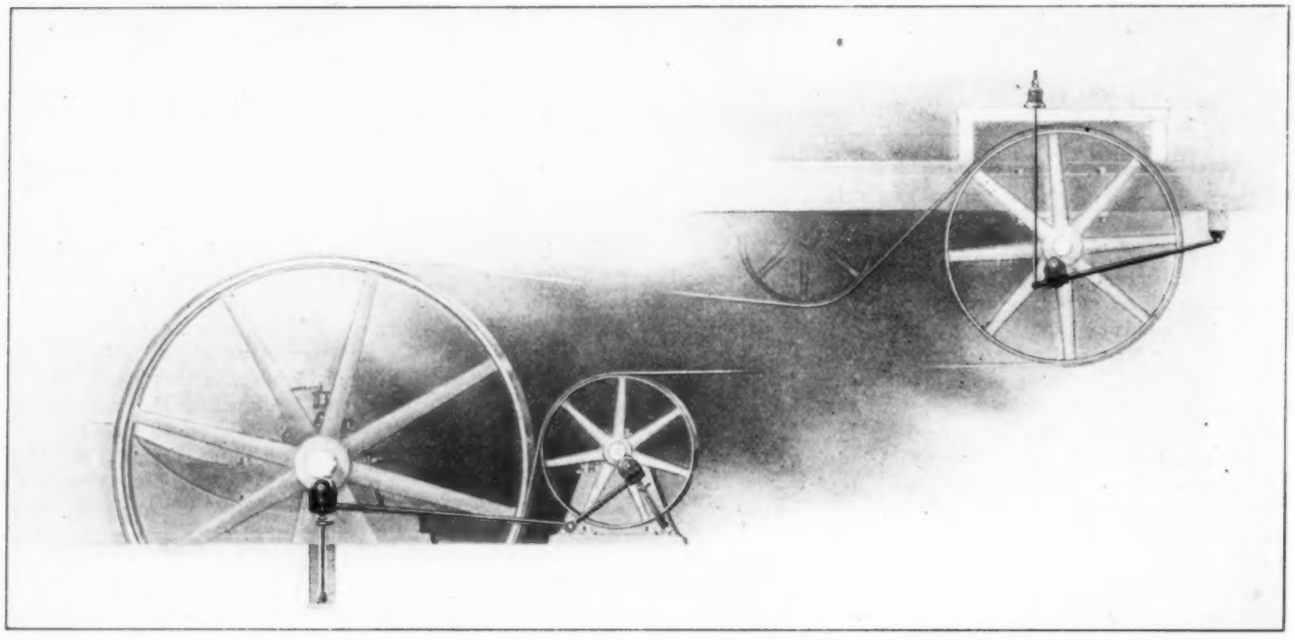


FIG. 1. APPLICATION OF RICE ROLLER RELIEF BEARING

These bearings are made in three sizes, and in their proportions bear no fixed relation with the diameter of a shaft; size No. 1 is calculated to carry a maximum pressure load of 2000 pounds; size No. 2, 4000 pounds, and size No. 3, 8000 pounds at any reasonable speed. They can be applied in sets of one, two or four; four of the larger ones being necessary in some cases, such as at an engine shaft and wherein the flywheel load might equal or exceed their combined rated capacity, the set of four giving a safe carrying capacity of 16 tons.

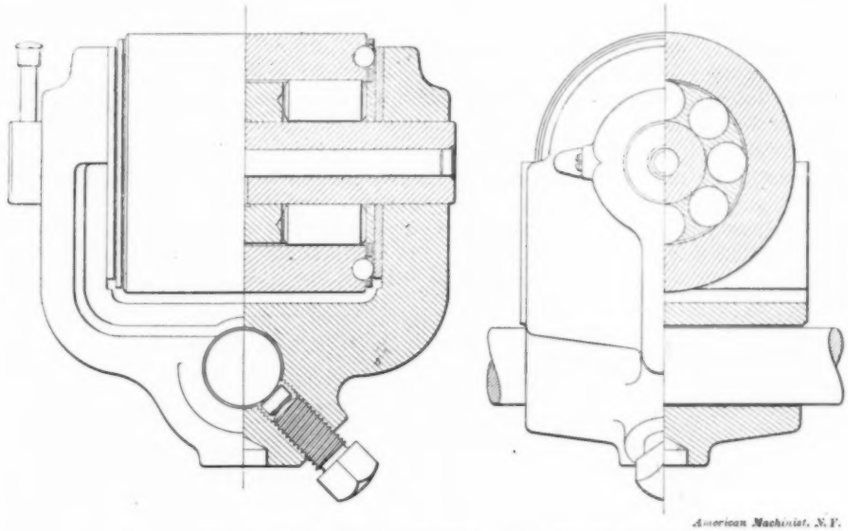


FIG. 2. CONSTRUCTION OF RICE ROLLER RELIEF BEARING

It should be remembered that in the application of these relief bearings none of the regular bearings is in any way disturbed but simply aided in the performance of its work so that in almost every case the relief bearings could be displaced in a moment's time and without a shutdown, simply throwing the full duty back on the regular journals. These bearings have been severely tested for three years in one factory, where they are applied to both ordinary shafting and on heavy engine and flywheel duty, as shown in illustration, and their application means not only relief to journal troubles, but it might mean such a saving of power as to defer the necessity of increasing the power plant.

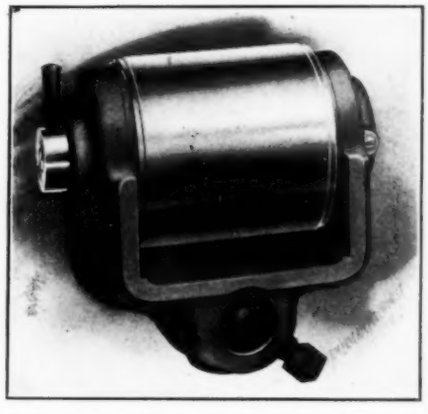


FIG. 3. COMPLETE BEARING

The friction relief bearing is made up, as seen in Fig. 2, of a cast-iron housing, an outer steel roll, a central main roll pin which is stationary in the housing. Between the main roll and the main roll pin are 16 rolls, eight upon each end of the housing and carried in a cage. At each end of the main roll are eight hardened steel balls. These balls bear upon two hardened steel washers, one at each end, and take care of the end thrust in the main roll. The smaller intermediate rolls have also at each end a hardened steel washer which takes the end thrust. The main roll pin is hollow, is partially filled with felt and forms an oil reservoir which lubricates the inside of the bearing. One end of this main roll is provided with a series of holes and a stop pin which permits of the oil tube standing in a vertical position no matter at what angle the roll may stand. All of the other materials with the exception of the intermediate roll cage are of hardened steel and ground to fit. Fig. 3 shows the complete bearing.

In service this housing is carried upon a tiller rod, the outer end of this being carried to an overhead support on the upper end of which there is a heavy spring which is calibrated so that by measuring the compression, or giving it a certain amount of compression a certain load will be carried by the relief bearing. In locating the relief bearing in relation to the shaft upon which it runs, it is so placed on one side or the other of the journal bearing that its action upon the shaft is directly opposed to the forces acting upon the shaft; that is to say, the weight of the pulley and the direction of the belt pull. It is made by the Pickering Governor Company, Portland, Conn.

Electric Hoists and Carriers

The economical handling of material is an ever present problem in modern shop management, and while the bridge traveling crane is indispensable in most shops, there are places where the newer carrier hoists have a clear field. This is particularly true in handling lighter material, which often forms such a large proportion of the work and which means either tieing up the large crane or an uneconomical load at best.

SPRAGUE ELECTRIC HOISTING SYSTEM ON STEAMSHIP PIER

The illustration shows an application of the Sprague hoist, which gives a good idea of its adaptability in many places

where one runway takes up little room and allows it to serve places not accessible to the large crane.

It is one of the cases where the advantages are so clear that little explanation is necessary. The operator controls the rail switches by the lever in his right hand, the action being already shown. This is made by the Sprague Electric Company, New York City.

Countershaft for Bench Lathes

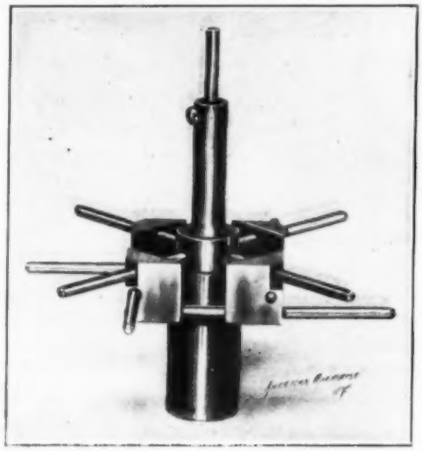
In order to secure the best results from bench lathe work it is necessary to have a countershaft which will drive it and its many attachments at the desired speed, as well as be convenient to operate. The countershaft shown is the solution as worked out by the Elgin Tool Works, Elgin, Ill.

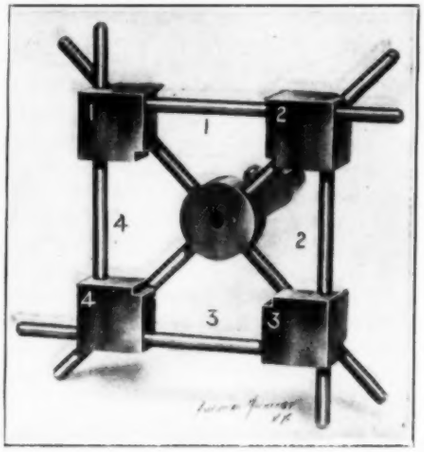
The backbone of this plan is the back or wall rod, which carries the hangers and the brace rod beneath which takes the strain of the lower end of the hanger bracket. These can be supported on the standards shown or fastened to the wall and can be just long enough for one machine or run the whole length of the shop as preferred, as it does not interfere with light in crossing windows nor injure the appearance of the shop.

Two belts come from the drive shaft to the two sets of tight and loose pulleys shown, the one at the right being used for low- and those at the left for high-speed work, such as the grinding work shown. In this connection the idler pulleys can be swung or moved into any position and fastened by the hand screws shown. The revolving tool rack can be fastened either to the upright, if one is used, or to the wall if preferred. The loose pulleys are fitted with patent bushings which require no lubrication, and prevent the throwing of oil over the lathe and operator. The belt shifters can be worked either by treadles or cords connected to the small bell cranks shown.

A Novel Centering Device

Of the many centering devices which are in use, the one shown herewith and recently put on the market by Patterson, Gottfried & Hunter, New York City, has more novelty to it than is usually the case. It consists of a central stem, carrying a center punch and having four projecting arms of round wire. On each arm is a block carrying a wire at an angle of 45 degrees from the central arms and having a hole for another wire from the adjoining block, to slide through. Wire 1 is fastened into block 1, wire 2 into block 2, etc. With these two sets of guide wires the blocks can be moved uniformly in or out from the center, so that when any round or square piece is placed against the end of the central stem, and the four blocks closed around it, it can be accurately centered by striking the back end of the center punch. It is very light, accurate enough for all practical purposes and small enough to be carried in the tool chest.

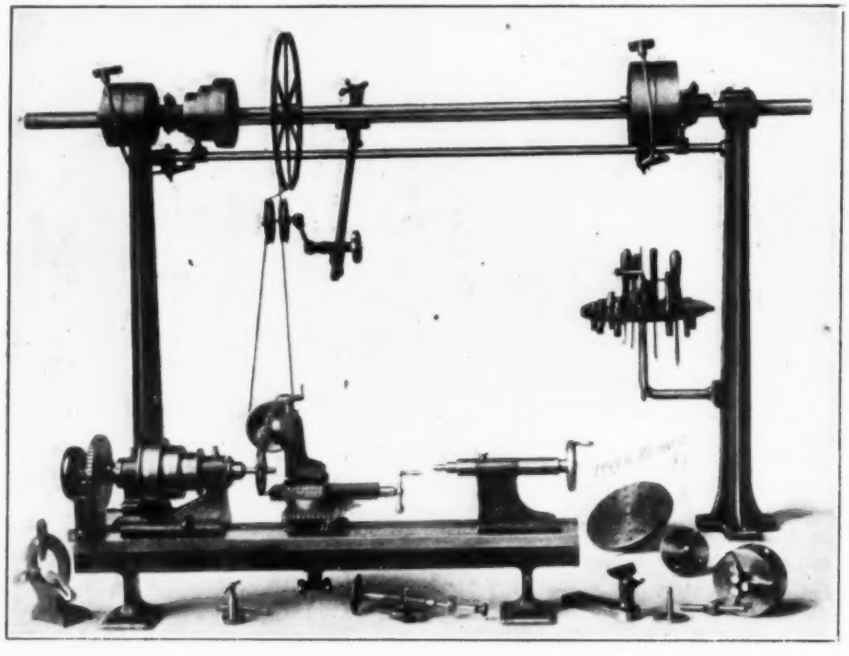




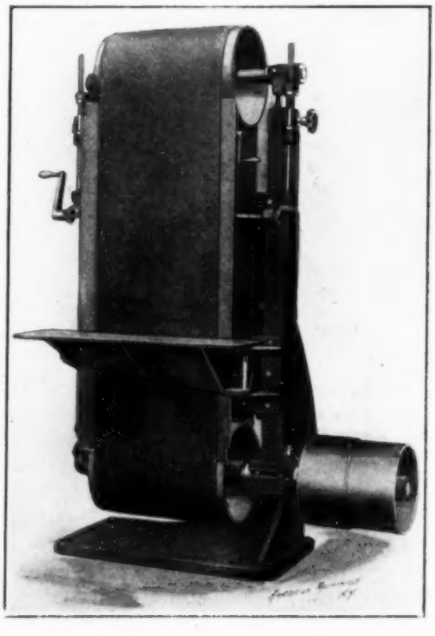
NOVEL CENTERING DEVICE

Belt Sander for Woodwork

In this machine the sanding belt runs vertically and is supported by a plate backing so that the work can be held against it firmly and squarely without injury to the belt. This runs at 4000 feet a minute. The table can be adjusted for hight from 18 to 42 inches from the floor or can be swung out of the way when the work can be handled best without it. A single



ELGIN COUNTERSHAFT FOR BENCH LATHE



BELT SANDER FOR WOOD WORK

crank adjusts both sides at once through the bevel gears and screws shown. The belt is 18 inches wide and will handle anything from the smallest work up to pieces 18x24 inches. It is made by the L. H. Gilmer Company, Philadelphia, Penn.

Combination Belting

The accompanying illustrations are of a patented combination belting made and sold exclusively by the Massachusetts Belting Company, 207 Congress street, Boston, Mass. It is composed of a number of parallel strands of selected steel wire, each strand being served or covered with a specially prepared hemp marline. These parallel strands are held together at regular intervals with a strand of the same steel wire served in like manner.

The parallel strands are usually composed of seven or nineteen wires, according to the strength and horsepower desired.

The belt is protected on the edges by a solid steel wire, served with hemp marline, to insure durability and make it practically proof against wear from shifting levers.

This belting is designed to combine the strength of steel and the durability and high coefficient of friction of prepared hemp marline. It can be either spliced or clamped, and the element of stretch is believed to be almost completely eliminated. It is also claimed for it that much narrower pulleys will suffice than those now in general use, and the expense of equipping a new factory will be greatly reduced by its adoption.

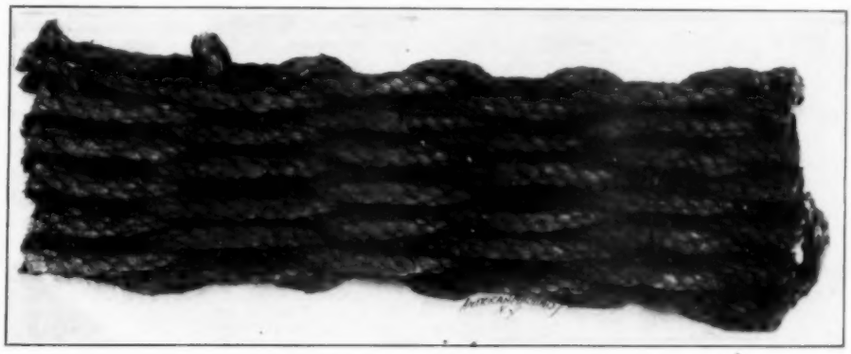


FIG. 1. SECTION OF COMBINATION BELTING

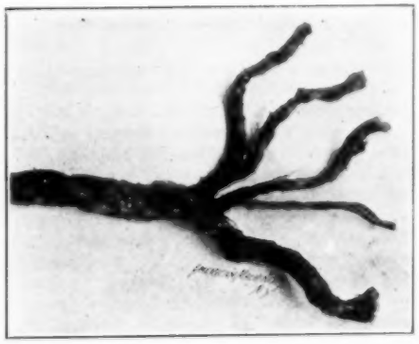


FIG. 3. HEMP MARLIN STRAND

Fig. 1 shows a section of combination belting before being used; Fig. 2 shows its condition after being used, and Fig. 3 shows how the prepared hemp-marline strands, with the steel core, are made up.

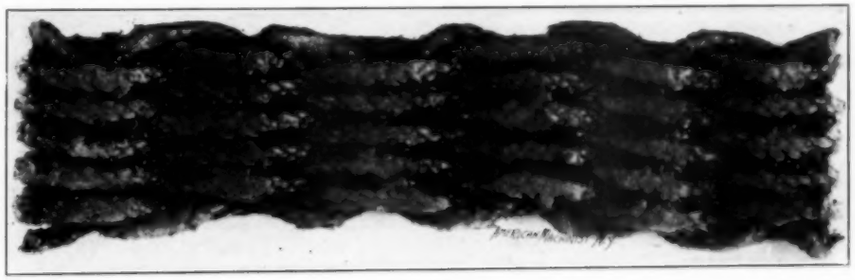


FIG. 2. BELTING AFTER BEING USED

The Davenport Bench Drill

The bench lathe shown herewith is designed for rapid, light work, and its features are all clearly shown in the illustration. While a two-step cone pulley is shown in place on the driving shaft, a three-step pulley taking a ¾-inch belt may be used instead when required. The cone shown is intended for a 1¼-inch belt. The capacity is for drills up to ¼ inch. The spindle has a vertical traverse of 2½ inches and the table a vertical adjustment of 4½ inches. The table is 5½ inches diameter, and the drill will operate at the center of a 7½-inch circle. The makers are the Blissfield Motor Works, Blissfield, Mich.

BENCH DRILL

The Davenport Tilting Vise

The halftone shows a tilting vise for use on the drill press, miller, planer, shaper, or bench. It can be adjusted to any position from the horizontal to the vertical and the work can thus be readily set at any angle desired. As will be seen, the work may be inserted and removed without altering the position of the tilting members. The elevating arms at the sides swing down over the sides of the base and do not interfere with the operation of the vise when it is being used in a horizontal position. The jaws of the vise, which are steel-faced, are 2 inches high, 5 inches wide and open 6 inches. This vise is made by the Blissfield Motor Works, Blissfield, Mich.

A TILTING VISE

It is stated that the highest generator voltage, according to the *Engineer*, in use is that at a hydroelectric plant at Manojlova falls, on the Kerka river, in the province of Dalmatia, Austria-Hungary, which generates electric current at 30,000 volts. This is fed direct to the line, and transmitted 21 miles.

A Planing Fixture for a Sensitive Radial Drilling Machine Arm

By J. T. Samuels

Figs. 1, 2 and 3 show a sensitive radial drilling-machine arm. This type of machine has become somewhat popular in England during the last 5 years. They are used for drilling insulating slabs for switchboard work, etc., and light castings which have a number of holes scattered over a comparatively large area, where a lot of handling would be necessary if the operation were done on an ordinary sensitive drill, and a large radial would be far too heavy, slow and cumbersome.

Figs. 4, 5 and 6 herewith show the illustrations of a fixture for use on a planing-machine table, when planing the arm for the saddle or head, which carries the spindle. This arm should be absolutely square with the hole *A*, which clamps the turned column; this hole is bored and faced first at the ends marked *B* and *C* on a Lucas type of horizontal boring machine. The surfaces marked *D*, *E* and *F* require planing. *G* is a steel rack for operating the saddle by the usual pinion and handwheel; this rack is, of course, secured in position after the machine has been partly assembled.

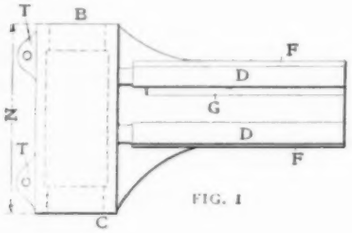


FIG. 1

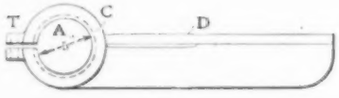


FIG. 2

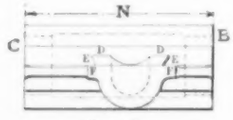


FIG. 3

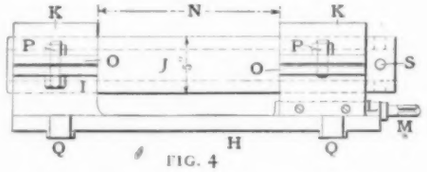


FIG. 4

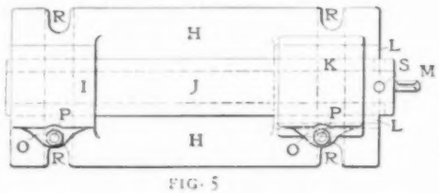


FIG. 5

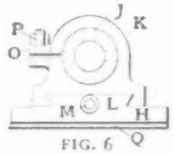


FIG. 6

American Machinist, N.Y.

A PLANING FIXTURE FOR A SENSITIVE RADIAL DRILLING-MACHINE ARM

Referring to Fig. 4, *H* is a gray-iron casting, with the bracket *I* cast solid with it, and accurately planed on the bottom. *J* is a hollow gray-iron locating mandrel accurately turned a good fit in the hole for the column *A*; this bar is supported, as shown, by the two brackets *I* and *K*, the latter being adjustable on the slide *L*, and operated by the screw *M* so as to bring the two machined faces on the inside of the brackets up against the ends of the casting marked *B* and *C*. This distance, marked *N*, varies somewhat, hence the reason for making the bracket *K* adjustable. This method also facilitates getting the work in and out of the fixture, an important feature. *O O* are two split lugs, with studs and bolts passing through, as shown, and tightened down by the nuts *P*. *Q Q* are two tenons planed on the bottom of the fixture to accurately fit in the T-slots of the planer table for locating the rig. The holes in the brackets *I* and *K* for carrying the locating mandrel *J* should be bored exactly square with these two lugs; upon the accuracy of this depends the quality of the product turned out. *R R R R* are the four slot holes for securing the fixture to the planer table by bolts in the ordinary way. The four holes *s* in the end of the mandrel *J* are for inserting a tommy bar or lever to withdraw it from the bracket *I* when inserting work and removing it after completion.

In operation the previously bored, faced and drilled column end of the arm is inserted between the brackets *I* and *K*, as indicated at *N*. To do this the nuts *P* require slackening, and *J* withdrawing and *K* slackening back. After the work is brought into position the rounded end of *J* is shoved through the hole *A* and *I* and *K* adjusted up to the face *C*. *P P* are then tightened and the work is accurately set in position as regards the relative positions of the column and arm. The latter only requires adjusting vertically, and packing up at the outer end and securing by a single central bolt and clamp. The two lugs on the back of the casting marked *T* in Figs. 1 and 2, should then be tightened securely on *J* by bolts passing through them, when the work is ready for operating on.

Business Items

The Robertson Drill and Tool Company, Buffalo, N. Y., recently filed a certificate of incorporation.

The American Automatic Switch Company has recently taken new quarters in the Hudson Terminal building, New York City.

The Cutler-Hammer Manufacturing Company, of Milwaukee, announces the opening of a district office in Cleveland, Ohio, 1108 Schofield building. The new office will be in charge of C. J. Kruse.

A favorable showing has been made by Wilmarth & Morman Company, Grand Rapids, Mich., in its business for the month of February, which came very close to trebling the business for the corresponding month last year.

The business of the Rockwell Engineering Company will hereafter be transacted under the name of Rockwell Furnace Company, which has increased its facilities with headquarters at 26 Cortlandt street, New York City.

Muralt & Co., New York City, have been awarded the contract for remodelling and enlarging the water power plant on the Peconic River, at Tower Mills, L. I. The old water wheels will be replaced by turbines of the vertical shaft type.

A contract was recently placed with Tate, Jones & Co., Inc., Pittsburg, Penn., for a large number of their "Kirkwood" natural gas burners, to be installed in the works of the Chanute Cement and Clay Products Company, Chanute, Kan.

The Crocker-Wheeler Company, Ampere, N. J., reports a number of large orders, among which is one for an 800 kilowatt and a 75 kilowatt, 250-volt generator; a 300-kilowatt, 125-volt lighting and power generator and two 125 k.v.a., 2300-volt, 60 cycle, 600 r.p.m. alternators, as well as many other equipments of smaller sizes.

W. I. Reich, consulting engineer, 245 West 24th street, New York City, has just engaged upon the work of enlarging the oxy-acetylene welding plant of the Riter-Conley Manufacturing Company to three times its present capacity. This company is manufacturing gas-light buoys and the seams or joints in the buoys are to be welded by oxy-acetylene process.

The corporation of Nilson, Miller Company, Hoboken, N. J., has been established at 1300 Hudson street, and will conduct an engineering and general machine shop business, making a specialty of designing and building to order electrical apparatus, gasolene engines, etc., for commercial vehicle, marine and stationary use. Also experimental work and special machinery.

Business Opportunities

Baker Bros., Frostburg, Md., will establish sash and door factory.

The Strubler Scale Company, Elkhart, Ind., is preparing to build a new factory.

The Union Pacific Railroad is to build a new roundhouse at Evanston, Wyo.

The Niagara Oil Stove Company, North Tonawanda, N. Y., will erect a new plant.

The Barnett Leather Company, Little Falls, N. Y., will erect a new factory building.

The Des Moines (Iowa) Paper Box Company is planning to build an addition to plant.

W. H. Copenhaver & Co., Chilhowie, Va., will rebuild hardware plant recently burned.

Fire destroyed the plant of the Whyte Wire Works, Medford, Mass. Loss, about $50,000.

Fire destroyed the plant of the Wrightsville (Penn.) Hardware Company. Loss, $30,000.

The plant of the Chase Leather Works, Hop River, Conn., was burned. Loss, about $20,000.

The Bettendorf Axle Company, Davenport, Iowa, will erect a new foundry to cost $400,000.

The West Coast Wagon Company, Tacoma, Wash., is making plans for a structural steel plant.

The Chicago Hardware Foundry Company, North Chicago, Ill., is erecting a new foundry building.

The Cincinnati Planer Company has about completed plans for the new addition to plant at Oakley.

The Pressed Steel Tank Company is now constructing the $30,000 addition to its plant at West Allis, Wis.

The Electric Welding Company, Cleveland, Ohio, has had plans prepared for a $10,000 addition to plant.

The tanning plant of Albert Trostel Sons, Milwaukee, Wis., was destroyed by fire, causing a loss of over $75,000.

The plant of the Burrill Johnson Iron Company, Yarmouth, N. S., was destroyed by fire. Loss, about $100,000.

The refrigerator department of the Racine (Wis.) Refrigerator and Ice Machine Company, was destroyed by fire.

The sewer pipe works of the Streator (Ill.) Clay Manufacturing Company was burned, causing a loss of about $80,000.

The Washington Pipe and Foundry Company is to enlarge plant at Tacoma, Wash., by an addition to cost $35,000.

The Stork Motor Company, Saginaw, Mich., will erect a new plant to be adapted to the manufacture of gas engines.

W. S. Black, Sr., Beatrice, Neb., is interested in a company to be organized for the purpose of manufacturing lawn mowers.

The Reed Manufacturing Company, Newark, N. J., making tin and galvanized ware, is to have a plant in Mason City, Iowa.

The Shelby Steel Tube Company, of Pittsburg, Penn., is having plans prepared for a new open hearth steel plant at Ellwood City.

The H. J. Reusch Machine Company, Newark, N. J., building jewelers' machinery, is said to be preparing plans for a new plant.

The Pacific Tank Company, of San Francisco, which recently purchased site at Oakland, will erect plant to employ over 1000 men.

Plans are now being drawn for the new engineering shops to be erected this year at the State University at Iowa City, Iowa.

The brass foundry attached to the plant of the Leland & Faulconer Manufacturing Company, Detroit, Mich., was destroyed by fire.

The James F. Powers Foundry Company, Elkton, Md., will erect a steel casting plant to have a capacity of about 20 tons a day.

The F. M. Curtiss Furniture Company, Jamestown, N. Y., whose factory was recently destroyed by fire, has commenced construction of new plant.

The Maxwell-Briscoe Motor Co., Tarrytown, N. N. Y. is asking for bids on material and supplies for its 1910 production schedule of 12,000 automobiles.

Plans are being drawn for the new buildings for the Phoenix Iron Works, Portland, Ore. These will include foundry, machine shop and pattern shop.

The Ensign Manufacturing Company, of Waltham, Mass., will locate in Brighton, where a new plant for the manufacture of its calculating machines will be erected.

The Vulcan Iron Works, Seattle, Wash., which has purchased site for a new plant for the manufacture of mining machinery, engines, mill supplies, etc., will need new equipment.

The Northern Normal and Industrial School, Aberdeen, S. Dak., will be in the market for some machine shop, foundry and blacksmith equipment. H. W. Mansfield, director manual and industrial arts.

The Isthmian Canal Commission, Washington, D. C., will receive bids up to 12:30 a.m., March 29, for locomotive coaling cranes, steel castings, differential, snatch and tackle blocks, wood boring machines, drills, bits, saws, shears, pipe cutters, carborundum wheels, rivets, screws, wire, etc., as per Circular No. 497.

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open bids as follows: March 23—Air drills, pneumatic grinding machine (schedule 1023); bolts, nuts (schedule 1024); gauges and glasses, oil cups (schedule 1025). March 30—Steam gauges (schedule 1034), water meter (schedule 1028), suction pumps (schedule 1031), bolts and nuts (schedule 1029), brass, steel (schedules 1028, 1030); brass pipe, copper tubing (schedule 1033); steel pipe (schedule 1000). April 6—Aluminum bronze (schedule 1017), sheet copper, rubber hose (schedule 1018).

New Incorporations

The Specialty Manufacturing Company, East Orange, N. J., has been incorporated. Capital, $150,000. Incorporators, Wm. A. Cooper, James A. Martin, Frank A. Spencer. Will manufacture iron, steel, copper, manganese, etc.

The Gresser Knitting Machine Company, New York, incorporated to manufacture machinery and supplies. Capital, $30,000. Incorporators, T. A. Sigrist, New York; M. Nydegger, Elizabeth, N. J.; H. W. Daniell, Laconia, N. H.

The Shore Instrument and Manufacturing Company, New York, has been incorporated as mechanical and electrical engineers, tool makers, machinists, etc. Capital, $25,000. Incorporators, H. E. Goldschmidt, N. P. Thomas, J. Hayes.

The Aluminum Goods Manufacturing Company, Newark, N. J., has been incorporated to manufacture goods, wares and novelties of aluminum. Capital, $750,000. Incorporators, Joseph Koenig, George Wits, G. A. Kruttschmitt.

The Empire Track Brake Company, New York, has been incorporated to manufacture engines, boilers, dynamos, pumps, Capital, $100,000. Incorporators, G. Q. Dean, 1628 Amsterdam avenue; P. K. Stauff, 231 Broadway, etc.

The National Manufacturing and Metal Company, Providence, R. I., has been incorporated to manufacture, sell and repair automobiles, machinery, etc. Capital, $25,000. Incorporators, J. B. Hartnett, David Rosenberg, John Mueller.

The Darby-Meeker Company, East Orange, N. J., has been incorporated to manufacture electrical apparatus. Capital, $125,000. Incorporators, C. D. Meeker, East Orange; John Darby, Summit, N. J.; H. D. Meeker, 166 W. 72d street, New York.

The Inter-Ocean Steel Company, Chicago, Ill., organized with $2,500,000 capital to manufacture railway ties. W. L. Jacoby, president. Directors, E. C. Converse, president Bankers' Trust Company, New York; W. T. Graham, president American Can Company, New York, and others.

Trade Catalogs

William S. Nicholls, 253 Broadway, New York. Folder illustrating and describing Hercules portable crane and hoist.

Bridgeford Machine Tool Works, Rochester, N. Y. Loose leaf catalog of engine and axle lathes. Illustrated, 9½x11 inches.

The Woods Engineering Co., Alliance, Ohio. Catalog of universal tool and cutter grinder. Illustrated, 8 pages, 6x9 inches, paper.

Carpenter Steel Company, Reading, Penn., Catalog of high grade steels, wire and forgings. Illustrated, 138 pages, 4½x6½ inches, paper.

H. P. Townsend Manufacturing Company, Hartford, Conn. Folder illustrating and describing multi-blow high speed riveting machines.

Universal Fluxine Company, Urbana, Ohio. Catalog describing universal fluxine for brazing cast iron. Illustrated, 8 pages, 3½x6 inches, paper.

Bush Terminal Company, 100 Broad street, New York. Pamphlet illustrating model loft buildings for shipper and manufacturers. 12 pages, 9x12 inches.

J. G. Blount Company, Everett, Mass. Catalog No. 12, describing grinding and polishing machinery and speed lathes. Illustrated, 46 pages, 6x9 inches, paper.

Bureau of Business Economies, Inc., Crozer building, Philadelphia, Penn. Catalog of automatic sorting and tabulating machines. Illustrated, 3½x6 inches, paper.

Gould & Eberhardt, Newark, N. J. Catalog describing improved Eberhardt's patent "High Duty" shapers and attachments. Illustrated, 50 pages, 6x9 inches, paper.

The Industrial Instrument Company, Foxboro, Mass. Bulletin No. 16, describing revolution counters, tachometers and tachographs. Illustrated, 16 pages, 8x10½ inches.

The Standard Tool Company, Cleveland, Ohio. Catalog No. 16, describing twist drills, reamers, taps, chucks, milling cutters, special tools. Illustrated, 304 pages, 4½x7 inches, paper.

The National Machinery Company, Tiffin, Ohio. Catalog E, describing complete line of bolt, nut, rivet and wire nail machinery. Illustrated, 198 pages, 8½x11 inches, paper.

Norton Company, Worcester, Mass. Catalog describing alundum, grinding wheels, grinding machinery, glass cutting wheels, India oil stones, etc. Illustrated, 168 pages, 6x9 inches, paper.

National Brake & Clutch Co., 16 State street, Boston, Mass. Catalog describing cork inserts for use on machinery where frictions are used and on pulleys. Illustrated, 20 pages, 6x9 inches, paper.

Buffalo Forge Company, Buffalo, N. Y. Catalog 20B, describing blacksmiths' and metalworkers' punches and shears, angle and tee iron cutter Illustrated, 24 pages, 6x10 inches, paper. Catalog 78B, describing blacksmiths' tools. Illustrated, 40 pages, 6x10 inches, paper.

Want Advertisements

Rate 25 cents per line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Miscellaneous Wants

Caliper list free. E. G. Smith, Columbia, Penn.

We buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Hand power bending tools, labor-saving, money-making. Estep & Dolan, Sandwich, Ill.

Light fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Machines designed; automatic, special. Practical working drawings. C. W. Pitman, 3519 Frankford Ave., Philadelphia, Pa.

Special machinery accurately built. Screw machine or turret lathe work solicited. Robert J. Emory & Co., Newark, N. J.

Light and medium weight machinery and duplicate parts built to order; tools, jigs, etc. MacCordy Mfg. Co., Amsterdam, N. Y.

A large English firm of machine-tool importers having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMERICAN MACHINIST.

Lathe, planer and milling machine work, gear cutting, etc., solicited; or machines built complete, by a shop making high-grade machine tools. Estimates furnished. J. F. Bowman, Box 4, Station B, Cincinnati, Ohio.

In order to settle an estate an attractive opportunity is open to a party with $150,000.00, competent to fill responsible position either in the sales or manufacturing department, to purchase an interest in a well and favorably known, profitable machinery manufacturing plant located in Pennsylvania, with an office and established trade in New York City. Address "Executors," care of AMERICAN MACH.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

CANADA

Mechanical draftsman, 14 years' experience, five of which were spent in the shop, wishes a position. Experience principally on engine and boiler work, stationary and marine. Good recommendations. Box 997, AMER. MACHINIST.

CONNECTICUT

Experienced machine-tool salesman with wide acquaintance in this country and Europe, wants position with dealer or manufacturer, inside or traveling. Box 6, AMER. MACHINIST.

INDIANA

Chief Draftsman—Shop experience, expert designer engine and mill work; systematic, economical results. Address Box 13, AM. MA.

Situation wanted as superintendent or general foreman by aggressive and successful manager of men. Interchangeable work. No cure, no pay. Box 8, AMERICAN MACHINIST.

MASSACHUSETTS

Wanted—A position as chief designing draftsman with company manufacturing steam and water valves. Address Box 24, AMERICAN MACHINIST.

Production superintendent who can reduce costs and increase production in the manufacture of valves, fittings and pipe for power plants. Box 991, AMERICAN MACHINIST.

MISSOURI

Position desired as tool-room or machine-shop foreman. Technical; 32. Box 21, AM. M.

NEW JERSEY

Mechanical draftsman wishes position. Box 25, AMERICAN MACHINIST.

Automatic and special machinery designer; age 31; graduate mechanical engineer; very capable on intricate machinery, fine apparatus, interchangeable work, tools, fixtures, experimental development; A-1 man for difficult work. Box 26, AMER. MACH.

NEW YORK

Wanted—Position as draftsman, detailer or tracer. Can furnish best of reference. Box 14, AMERICAN MACHINIST.

Draftsman wishes position in New York City. Executive ability, wide experience in designing automatic machines, tools and fixtures. Box 12, AMERICAN MACHINIST.

Superintendent of inspection bureau, young man wide experience; will consider a change. Tool, gage or interchangeable parts; good organizer. Box 986, AMERICAN MACHINIST.

Mechanical engineer, well up in design, shop supervision and business methods, experienced technical school teacher, wants position in metropolitan district. Box 20, AMER. MACH.

Technical graduate, age 26, two years' experience as machinist, four years as draftsman on elevators and one year on railroad cars, wants position. Box 9, AMER. MACH.

Position as superintendent or designer and developer of special and automatic machinery. Experience of 20 years in superintending, designing and shop work on light and medium machinery. Box 18, AMERICAN MACHINIST.

OHIO

Wanted—Position as superintendent of a shop in which I can become financially interested. I am 30 years of age and have a family. I am a practical machinist and have been foreman for eight years in a shop on engines and paper mill machinery. Box 19, AMER. MACH.

Engineer of established reputation, wide experience apprentice to works manager, intimate knowledge of best shop and machine tool practice on heavy work, gilt-edged record, is open for engagement as works manager with full responsibility and can deliver the goods. Box 865, AMERICAN MACHINIST.

WISCONSIN

Experienced designer, age 29, on machine tools, fixtures and dies for interchangeable work. Three years' shop experience. Box 17, AMERICAN MACHINIST.

Help Wanted

Classification indicates present address of advertiser, nothing else.

CANADA

Wanted—Thoroughly up-to-date first-class man to set piece work prices in a large electrical factory in Canada. Applicant must state experience in this line as well as other lines and references; also salary required. None but first class men need apply. Box 972, AM. MA.

CONNECTICUT

Wanted as superintendent, a man with rare executive ability, A-1 character, first-class mechanic, capable of taking charge of a large plant. Box 22, AMERICAN MACHINIST.

ILLINOIS

Technical graduate wanted for position of senior draftsman by concern manufacturing elevating, conveying and power transmitting machinery. Executive ability essential and knowledge of light structural steel work desirable. Give nationality, age, experience, references and salary expected in first letter. Address "Ramsay," care AMERICAN MACHINIST.

INDIANA

Wanted—4 toolmakers, 6 lathe men, 1 foreman. Good wages, steady employment. Box 943, AMERICAN MACHINIST.

KENTUCKY

Working Superintendent—General repair and job shop complete, with foundry and doing boiler and sheet steel and steam forge work, wishes superintendent who can invest $5000.00. Plant and business invoice $20,000.00 (twenty). No incumbrances. Give full experience, age, etc. Box 16, AMERICAN MACHINIST.

MASSACHUSETTS

Wanted—For the engineering department of a manufacturing establishment building hydraulic machinery, a young college graduate with one or two years' shop and drawing room experience; one that will develop into an engineering salesman. State age, education, experience, wages to start, and send samples of drawings. Box 10, AMERICAN MACHINIST.

A company manufacturing small metal parts for the trade, screw machine work, press work, etc., wishes to get in touch with a first-class practical man to take entire charge of the factory. An exceptional opportunity for some capable man to get started for himself, as we are prepared to dispose of an interest in the business if mutually satisfactory. A good salary and percentage of factory profits to anyone who can make good. In reply state your experience, habits, position you now hold and any other information in regard to your qualifications. Box 23, AMERICAN MACHINIST.

MICHIGAN

Tool and Diemaker Wanted—An A-1 man on small work. Good, steady position with bright prospects for right man. Box 11, AMERICAN MACHINIST.

NEW JERSEY

Strictly first-class mechanical draftsman wanted; one with experience gained in large steelworks and who is able to design from preliminaries submitted. Give references and state nationality, age, training, etc. "Capable," care AMERICAN MACHINIST.

Salesman—A traveling salesman who is now selling the machine or railroad supply trade, to carry a high grade bearing metal (babbitt) as a side line, on liberal commission basis. Address, with full particulars, Lakewood Metal Co., Box 182, Lakewood, N. J.

NEW YORK

Wanted—A draftsman with experience in making patent office drawings; familiar with electrical work; steady position with reliable concern in New York City. State age, experience and salary expected. Box 3, AM. M.

OHIO

Wanted—Assistant superintendent for machine shop employing 60 to 75 men. Must be competent to take full charge of the men and produce economical results. Best of references required. Box 15, AMERICAN MACHINIST.

Wanted—Production manager. An old established company, members A. L. A. M., located in a good factory, modern equipment, etc., making 500 cars of highest grade this year, and going to make 750 to 800 for 1910 season, design of which is now ready, wants a capable man to manage the entire manufacture, from the getting of material to shipping cars. Unless you have held a similar position with a successful automobile concern, do not apply. All applications confidential. Address "Production Manager," AMERICAN MACHINIST.

PENNSYLVANIA

Wanted—An expert reamer grinder. Box 987, AMERICAN MACHINIST.

Draftsman—An Eastern college has a position open for a technical graduate as junior instructor of mechanical drawing. Applicant must have some drawing office experience. Give age, education, experience with references and salary expected. Box 993, AMER. MACH.

Wanted—A competent shop manager who is practical enough to secure maximum production at minimum cost, and who has sufficient business capacity to manage office and handle finances of a company doing $250,000 business annually. All replies treated strictly confidential. Box 984, AMER. MACHINIST.

Wanted—Chief draftsman of good designing ability. A first-class man with wide experience covering hoisting engines and general machinery, boiler and steam plants. Prefer a man with college education and of good executive ability. Good salary to a first-class man. In replying state experience and age, giving full particulars. Box 956, AMERICAN MACH.

WASHINGTON

Wanted—Sober, industrious young man; must be a first-class, up-to-date machinist, fine filer and toolmaker, competent to manufacture finely made and finished gun sights. State age, experience and wages expected on yearly contract. W. F. Sheard, 908 "A" St., Tacoma, Wash.

For Sale

Valuable Canadian Patent—On labor-saving machine being rapidly introduced in the United States. Reynolds Machine Co., Moline, Ill.

For Sale—Clayton air compressor (6-inch stroke) and medium size receiver. Used very short time. P. D. Collins & Co., 159 Leonard St., New York.

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Accurate Textile Machinery Making

Accurate Drawings with Dimension Limits and Highly Organized Small Tools Are Used in Manufacturing the Mayo Improved Knitting Machine

EDITORIAL CORRESPONDENCE

The impression that all textile machinery is made by rough-and-ready methods and is lacking in elements of precision and interchangeability is very commonly met with, yet it is wide of the actual facts. Some textile-machine-building firms produce a product which is in every way as refined in design, accuracy and method of manufacture as is sewing machinery, typewriters and the best of shoe machinery. An illustration in support of this statement is the hosiery-knitting machine built by the George B. Mayo Machine Company, of Laconia, N. H. The purpose of this article is to show a few of the machine-shop devices used by this firm and to outline briefly the scheme of manufacture.

Accurate drawings and highly developed small tools are at the foundation of successful interchangeable manufacturing. Without these factors the expression "manufacturing" does not really apply to the scheme of production. Figs. 1 and 2 show an important part of the knitting machine called the bed-plate, together with the special small tools used in its production and a drawing illustrating the character of limits that prevail on all of the parts of the machine.

The drawing of Fig. 2 is a good illustration of a sane method of making working drawings. Only a part of the dimensions have been reproduced, yet the others were worked out with the same degree of care. Unimportant dimensions are expressed in inches and common fractions thereof. Precise dimensions are expressed in thousandths of an inch, and wherever possible maximum and minimum limits are added. The use of limits as tending to accurate, and at the same time cheap production, has been discussed in the past at great length, but unfortunately many attempts to use such limits have met with dismal failure. One reason therefor has probably been an injudicious selection of the maxima and minima for different classes of work. The experience gained on the work that we are discussing should be a proof of the possibilities of success in such a system provided it is worked out on a suitable basis.

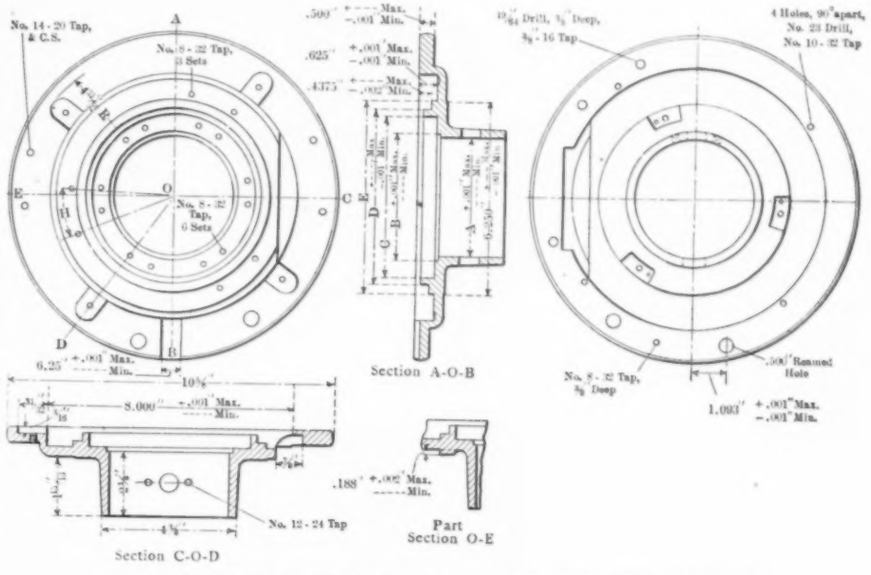

No. 14 - 20 Tap, ∠ C.S.
No. 8 - 32 Tap, 3 Sets
No. 8 - 32 Tap, 6 Sets
Section A-O-B
No. 12 - 24 Tap
Section C-O-D
Part Section O-E
4 Holes, 90° apart, No. 23 Drill, No. 10 - 32 Tap
No. 8 - 32 Tap, ⅜ Deep
Reamed Hole

FIG. 2. SPECIMEN DRAWING SHOWING SYSTEM OF DIMENSION LIMITS

The special tools illustrated in Fig. 1 need very little comment. At the right is seen a six-spindle drilling attachment which lends itself to rapid and accurate work. To the left of this drilling fixture are two large plug gages for the main fits of the piece. In front are a group of smaller tools, snap gages and a ring-drilling fixture. At the left of the piece itself, indicated by the letter *A*, are other special tools whose purpose and use show so clearly that no particular mention is needed. The broad fact that we seek to bring out is the refinement with which these tools have been designed and made in order to produce accurate, interchangeable work, remembering at the same time that we are now discussing a machine in the textile field.

Inspecting

On interchangeable work careful inspecting is as important as refined tools. Here, every part that is manufactured goes through the hands of an inspector or one of his assistants. It cannot be taken to the stock room or used in any manner without his approval. His work of inspecting also extends to individual opera-

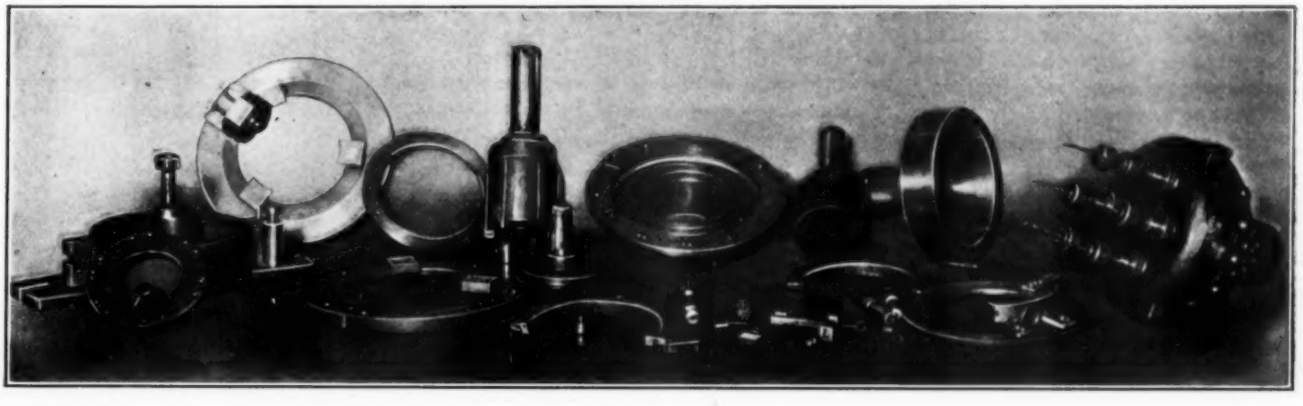


FIG. 1. A GROUP OF SMALL TOOLS USED FOR ONE OF THE PARTS OF THE MAYO IMPROVED KNITTING MACHINE

tions as they are carried out on the machine tools. To that end a certain part of his time is spent in passing among the machines in the production department, testing individual features and making sure that the wear of tools, changes in setting or other factors do not produce inaccurate work. Should a part or group of parts reach the assembling room and fail to aline or function properly in a machine, a careful search is at once instituted for the cause of the trouble; the pieces themselves are not changed or altered until this cause has been positively determined and a course of corrections mapped out that will be consistent, not only for the parts under consideration, but for parts of the same kind which have gone before and are to follow.

The Piece-work Adjuster

The method of wage payment, to a large extent, is for piece work. The setting of the rates is in charge of a young man who is known as the piece-work adjuster. In addition to setting the rates, he is expected to be able to perform or to demonstrate the performance of any operation upon which he sets a price within the time limit or for the rate which he determines. If a rate is set at a figure which an individual workman thinks is too low, and an appeal is made to the adjuster for an increase, the probabilities are that this adjuster will operate the machine itself, or at least set the speed and feed and actually demonstrate by running through a small lot of pieces that the rate is fair. No loophole of argument is left after the adjuster has actually supervised the operation in front of the workman's eyes, and showed him that the work can be done in the time and for the price set. The spirit of not being "beaten by the other fellow" has a great influence under such conditions. It goes without saying that the adjuster must be a workman of exceptional ability in order to supervise any machine tool or operation in the plant on piece work and do it successfully.

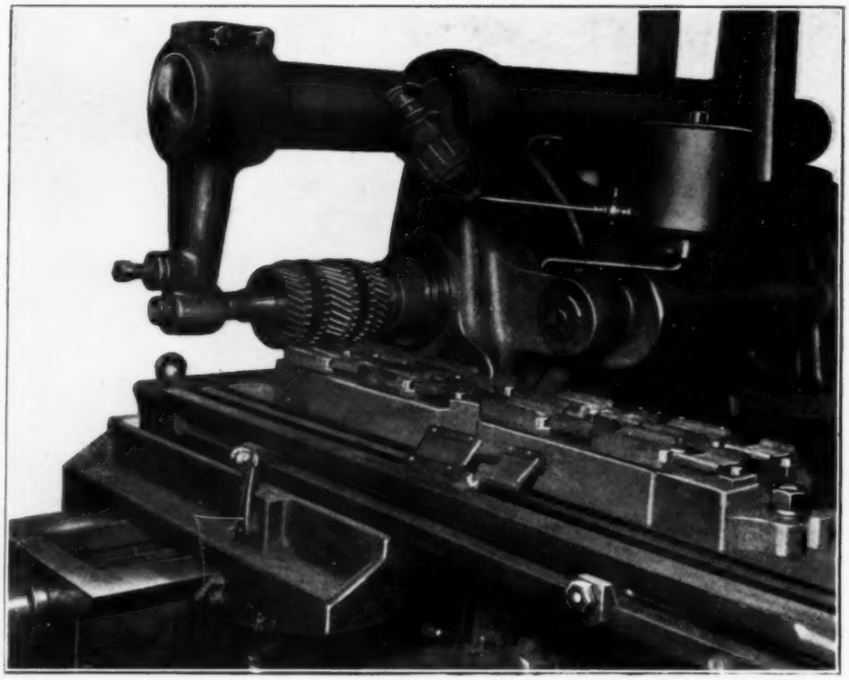


FIG. 4. MILLING FIXTURE FOR CONTINUOUS MILLING

A Surface-grinder Attachment

A large number of very thin pieces, made from tool steel are used in connection with the needle- and stitch-handling mechanism. Some of the operations of manufacture on these parts call for accurate surface grinding, giving rise to the problem of how to hold these pieces successfully on a magnetic chuck. The device illustrated by Fig. 3 has been in use for over two years and consists of placing a heavier piece of metal across the thin pieces to be ground, in such a way that the magnetic flux will hold the heavier piece and thereby clamp the thin pieces to the surface of the chuck. By this means a portion of the surface of the piece to be ground is finished, the clamping piece is then shifted and the rest of the surface can be successfully machined.

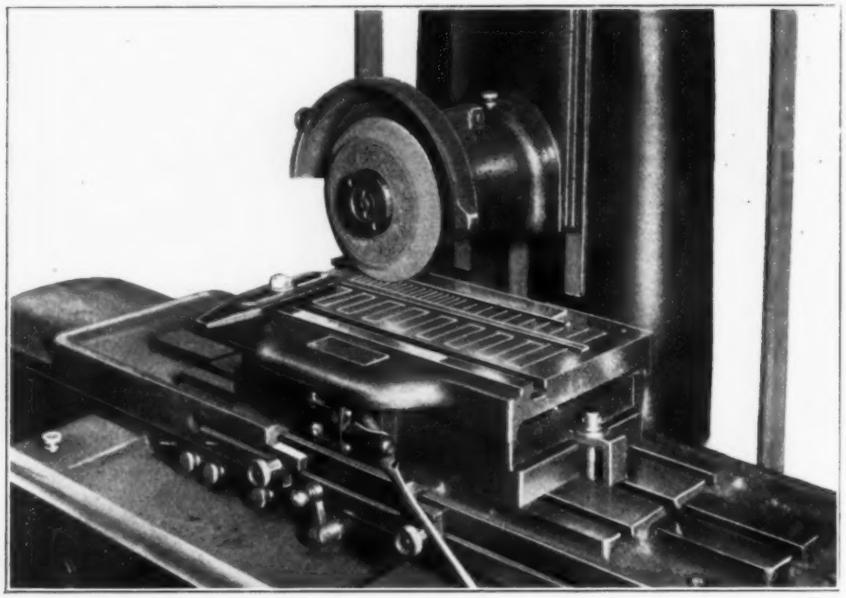


FIG. 3. A MAGNETIC CHUCK ARRANGED FOR HOLDING THIN PIECES

Continuous Milling Fixtures

Fig. 4 illustrates a type of milling fixture which, while not new, is still worthy of consideration where accurate and cheap production is needed. It is a long, duplex fixture capable of holding eight pieces of the kind shown resting against it. These pieces are arranged in two rows and are milled with a gang of cutters as shown. In use the fixture is strung full of pieces and the operation of milling started. After the first two pieces at the left-hand end have been milled, they are removed and replaced by unfinished pieces while the operation of milling is continuing on the next set. This process is continued, and becomes a continuous milling operation, as finished pieces are removed and rough pieces inserted while others are being operated upon. This is one of the devices which is used to a great extent in the milling department of this knitting-machine factory.

A Two-spindle Cam-cutting Attachment

A valuable and suggestive two-spindle cam-milling attachment is illustrated by Fig. 5, but unfortunately the position from which the photograph was taken was not happily selected, and thus the device

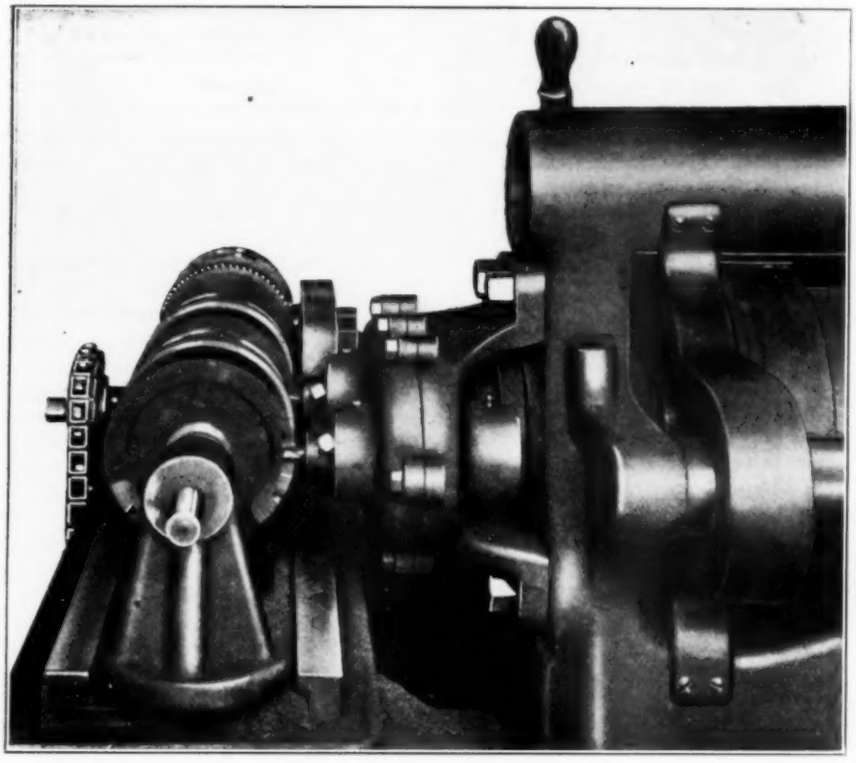


FIG. 5. A TWO-SPINDLE CAM CUTTING ATTACHMENT

does not show as clearly as we would wish. Upon the nose of the milling-machine spindle is placed a gear meshing with other gears and driving two horizontal cutter spindles. Both of these spindles with their cutters can be seen. At the farther end of the attachment is placed the leader, which has two cam grooves. Motion for the fixture is taken from the feed pulley at the rear of the miller. Two cams are strung on the arbor, the end of which can be seen projecting through a bracket in the front of the picture. After one groove has been finished, the entire fixture is shifted, in order to bring the cutters in line with the second pair of grooves to be cut. At the same time the leader pin is shifted into the proper groove in the leader.

A Hardening Machine for Thin Pieces

There is a small, thin, tool-steel piece known as a "sinker," that is used in great numbers in these knitting machines. Its function is to hold the stitch when it is released by the needle. These pieces are from 0.01 to 0.012 inch thick, and are of a shape as shown on the firebrick in the illustration, Fig. 6. This illustration shows a hardening machine for these thin pieces. The heating hearth consists of a firebrick covered by a steel plate, upon the center of which is directed the flame of a gas blowpipe. The pieces to be hardened are placed in this heating zone on the steel plate, and after they are properly heated they are snapped by a wire poker onto the hardening anvil at the left. This hardening anvil consists of a cast-iron base cored out inside for a water chamber. Raised a short distance above it can be

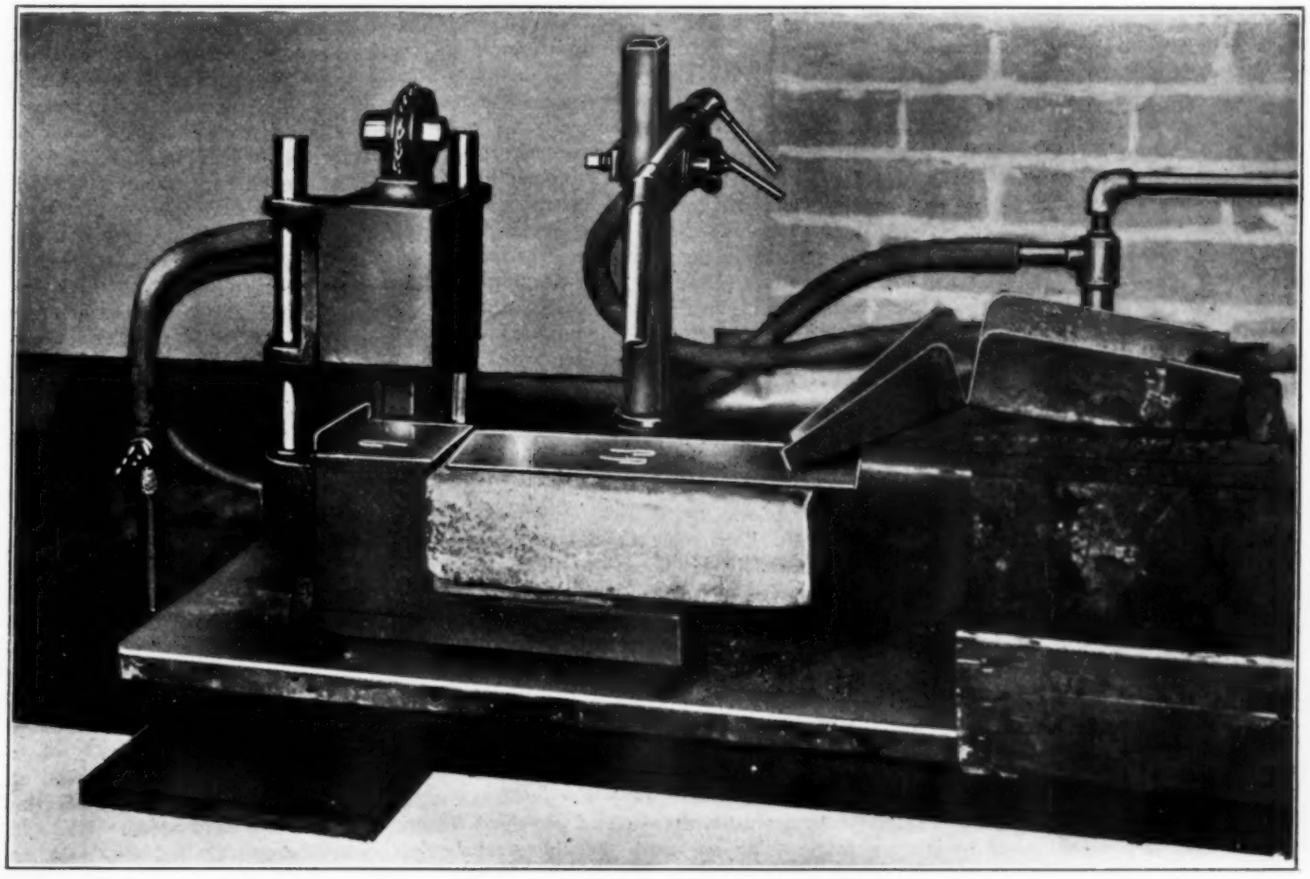


FIG. 6. A HARDENING MACHINE FOR VERY THIN PIECES

seen a hammer, which is also a block of cast iron cored out for passages for cooling water.

In use the hammer is lifted by a foot treadle, the properly heated piece is snapped onto the anvil, and the hammer is dropped. It needs to remain in contact with the heated piece but an instant in order to cool it, and at the same time hold it perfectly straight. In fact, after this instant of contact the hammer is lifted, and the boy operator snaps out the hardened piece with his forefinger. While the pieces are not stone cold, they are cool enough to be held in the hand without discomfort. This little machine is very rapid in operation, as 9000 pieces are hardened per day by one boy. The hose for the circulating water is seen at the left-hand end. This water enters the hammer first, passes through it, then to the anvil block, and from the anvil block to waste. Thus one source of supply and one system of piping serves for both hammer and anvil. The little machine is peculiarly effective in solving the difficult operation of hardening very thin pieces, and at the same time keeping them straight.

From Piece Work to the Premium Plan

By F. A. Halsey

The premium plan as originally published was essentially an addition to the day's-work plan, the workmen being supposed to be continued at an existing rate of daily wages with an additional premium based on an increase of output, and in most, if not quite, all discussions of the plan it has been stated in words, or tacitly assumed, that the method of payment prior to the use of the premium plan was by simple day's work. This has been true of everything that I have written upon the subject. During my shop life I had no experience with piece work and no occasion to devise a method of changing from piece to premium work, and although many inquiries have come to this office asking for details of the methods to be followed in cases of this kind I have always felt that, in view of the above-described situation, I was not competent to offer advice of value.

Carl G. Barth's Plan

Carl G. Barth, who is so widely and favorably known by his work in association with Fred W. Taylor, has had this problem before him and has worked out a solution which in several applications has proved entirely successful. The idea is simply to start with a wages-per-piece limit instead of a time limit. The workman is put on an hourly wage rate in place of the previous piece rates and he is then offered a premium of part of the difference between the wages-per-piece limit and his wages for the time consumed in doing the work.

Thus, suppose the wages-per-piece limit for a given piece of work to be $2.50, the workman doing it having an hourly rate of 25 cents, and suppose he does the work in 6 hours. Under these conditions the workman's earnings and the new cost would appear as follows:

Wages-per-piece limit	$2.50
Hourly wages for six hours	1.50
Total saving of wages per piece	$1.00
If the premium is ⅓ the total saving the premium earned per piece is $\frac{\$1.00}{3} =$	$0.33⅓
Wages for six hours	$1.50
Premium per piece	0.33⅓
Total cost of work	$1.83⅓
Original cost of work	$2.50
New cost of work	1.83⅓
Saving to employer	$0.66⅔
Workman's wages for six hours	$1.50
Premium	0.33⅓
Workman's total earnings for six hours	$1.83⅓

Workman's earnings per day of ten hours

$$\left(1.83\tfrac{1}{3} \times \frac{10}{6}\right) = \$3.05$$

Workman's new earnings per day	$3.05
Workman's old earnings per day	2.50
Workman's premium per day	$0.55

Adaptability to Varying Capacity of Men

A feature of the plan of which Mr. Barth makes a great point is that it automatically takes care of different rates of hourly pay based on the capacity of different men to produce varying amounts of work by, in effect, giving a low-rate man an extension of time before the limit is reached. Thus under the rate assumed above, the workman having a rate of 25 cents per hour has, in effect, a 10-hour limit which must be cut down before he earns a premium; but, on the other hand, a workman having, say, a 20-cent rate per hour, has, in effect, a 12½-hour limit which he must cut down before earning a premium. Or, to put it otherwise, a workman earning 20 cents an hour would, by doing the work in 7½ hours, earn the same premium that the 25-cent workman earns by doing it in 6 hours. This is a distinct advantage over the time-limit plan which handicaps the low-rate workman by giving him the same time limit as that given to the workman getting a higher daily rate.

In Mr. Barth's practice the task idea is introduced by requiring the workman to do a certain per cent. better than the base rate before any premium is paid, the premium when paid being, however, based upon the entire saving of time. This feature is not, of course, essential, and may be employed or not as the user of the plan prefers.

The Proper Premium Rate

As against a premium of one-third the total saving on which the above tabulation is based, Mr. Barth, like so many others that have adopted the premium plan, pays a premium of one-half the saving. He does this, however, after a preliminary time study which frequently results in the reduction of the wages-per-piece limits below the previous piece rates. Under these circumstances, a premium of one-half the saving is, I believe, justifiable, but when the limit is simply taken from existing cost records, I believe it to be too high and that a premium of one-third the saving is all that the manufacturer should pay, and this whether the limits are based on records of the day's-work plan or on those of the piece-work plan.

There is an appearance of fairness about a half-and-half division which makes it very attractive on the surface. Experience shows, however, that it is an unnecessarily high rate, the incentive under one-third the saving being sufficient in nearly all cases to bring about an increased output and to lead to very substantial increases in the wages earned.

This conclusion is not a new one, as I have advocated a premium rate of one-third the saving from the beginning and it is no more than proper to add that accumulated observation only serves to confirm the wisdom of the conclusion. I know of one conspicuous case, which ultimately became a local bell-wether and was largely followed, in which, against my own advice, a premium rate of one-half the saving was established and in which the manager who did it now regrets the decision.

The great gain in the production of petroleum in 1907 over 1906 required such a drain on all the great pools and developed so large a stock of unused crude oil that a further increase in 1908, says the *Journal* of Franklin Institute, was not logical, as a matter of either finance, trade requirements, or available petroleum resources. As the year went on, unprecedented floods in May and June and again in November brought disaster to the pipe lines of Oklahoma; and these storms also left a record of numerous oil tanks destroyed by lightning. In the Eastern fields the severe drouth also seriously interfered with well drilling. Nevertheless, the actual record of the year shows a total beyond all records—between 175,000,000 and 180,000,000 barrels, compared to 166,000,000 in 1907, or between 5 and 9 per cent. increase. The total value is proportionately greater still, for the price of the product in California increased, and it remained steady in other fields, except the Gulf, where a comparatively groundless fear of overproduction from the new Markham and Goose Creek fields caused depression. The increases came from the steady growth in Illinois and California. Neither field showed phenomenal development. California responded to the higher prices consistent with depleted stocks, and Illinois showed the continued effect of the great investments of the previous year.

System Too Little—System Too Much

Every Shop Needs Brains—but, Better Have Them in the Heads of Live Workmen Than in the Dead Vitals of a System

BY M. C. JACKSON

John Smith was a machinist who had served his time in the oil country. Believe he was acquainted with Osborne, who writes "Echoes" from that locality, but do not know if he came from the Grey Sand district or whether, as an apprentice, the stench of Lima crude assailed his nostrils; at any rate he came into possession of money, moved away from the scenes of his childhood and opened a machine shop.

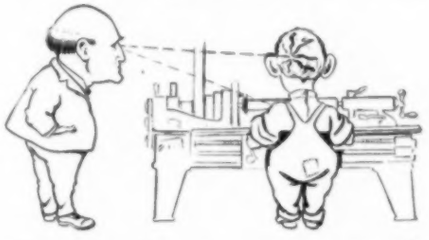
Now, in the matter of issuing orders Smith's method was to call Bill, Jack and Harry, explain what was wanted, mark

SMITH WOULD EXPLAIN WHAT WAS WANTED AND MARK ON A POST THE NUMBER OF MACHINES REQUIRED AND WHEN SHIPMENT WAS EXPECTED

on a post with chalk the number of machines required and when shipment was expected. This started the ball rolling and although it went over many rough places it eventually landed on a flatcar within a reasonable length of time; payment was then forthcoming. It was undoubtedly a primitive method, but seemed to work fairly well in Smith's shop for he had a pleasing and attractive personality combined with considerable shrewdness and a good practical knowledge of several trades. Among his accomplishments was one now almost extinct, viz., that of telling by eye whether or not a machine was working at about the right speed and feed, and the faculty to judge with reasonable accuracy the time necessary to do a job. These two particular qualities were partly due to a natural aptitude and partly to the school of experience in which he received his training. The men were well aware of this ability on his part, in fact they often imagined the boss wiser than he really was; this belief caused them to regulate things accordingly. Thus we find that when Smith made unanticipated visits to the storeroom or scrap heap he usually found the former neither over nor under stocked and few spoiled parts or usable pieces in the latter.

Another characteristic of Smith was a considerable contempt for what he termed red tape, combined with sufficient sense to say little on the subject. He thus avoided arguments on the subject of system, well knowing that it is hard to beat a man at his own game. He fought shy of modernizing engineers, systematizers and such, believing that if he hired a man to organize the shop, it was a tactical acknowledgment that he didn't know how himself. His relations with the workmen were good; he treated them as men, not machines; he knew when they were doing their best or shirking, and they respected him for it. They knew that when he threw a responsibility upon one of them he had confidence in the man and he nearly always made good. When in doubt about a move he occasionally asked the advice of some of his men and actually followed it on more than one occasion.

Now, as could be expected from the lack of system, there was considerable confusion in the shop over minor matters of detail which often consumed time, and occasionally delayed a job, or caused the cost of machine time or erection to be more than it should have been; but on the average, profits were reasonable and from time to time additions were made to floor space and equipment. Watered stock or overcapitalization were not fac-



THE MEN WERE WELL AWARE OF SMITH'S ABILITY TO JUDGE WHETHER THEY WERE WORKING OR SHIRKING—COULD FEEL HIS GAZE UPON THEM

tors and, therefore, he did not have to pay dividends on capital not actually invested.

The Manufacturing Establishment

"But Smith had a neighbor,
In the next block was Brown."

Brown also ran a shop, but, being somewhat more pretentious in extent, he dignified it by the name, "Manufacturing Establishment."

Now Brown lacked Smith's ability to tell when a man was doing a man's work, or a machine doing a machine's work. True, he had ideas on the subject which were passable, but he lacked the self-confidence to fully exercise his own judgment. He also seemed to lack confidence in his workmen; rather imagined them all for self and nothing for Brown.

Just how Brown came to be in complete and undisputed control of the "manufacturing establishment" no one seemed to know, but there he was, and apparently to stay. He was quite intellectual; in fact, a graduate with high honors from one of America's best institutions of learning. As a mathematician he excelled. His chief delight seemed to be in making $\int$ marks when engaged in an abstruse calculation. Whist and chess he despised, but of a summer evening he would sit on

his back porch and figure out when the next eclipse of the moon was going to occur (unless interrupted by his wife). During his senior year in college he had met at lectures a systematizer or two and became enamored of their beguiling ways; so, soon after the advent of Brown into the affairs of the "manufacturing establishment" there appeared upon the scene several smooth-talking, professional-looking men who proclaimed themselves to be the only living and real genuine *I ams* in the field of systematizing. Ac-

"HE ALSO SEEMED TO LACK CONFIDENCE IN HIS WORKMEN; RATHER IMAGINED THEM ALL FOR SELF AND NOTHING FOR BROWN"

cording to their version they had studied all known forms and absorbed the wisdom of the sages. Compared to them all others were in the primary grade.

A Two-Faced Decimal Clock

Dating from the appearance of the systematizers things began to happen. One of the first innovations was a decimal time system. As an adjunct to this there was installed a clock having two dials, one on the front, the other on the rear; the former was for straight, the latter for overtime. This clock was mounted upon a pedestal which automatically turned into view the proper dial and apertures for inserting time cards. It was a novelty for a time and the men took quite a pleasure in noting how many visitors were confused or missed trains by looking at it, naturally supposing it to be the usual thing. Most of the men bought Ingersoll watches in order to relieve their brains of the abnormal strain necessary to calculate just what time it really was in old-fashioned hours and minutes. Yet as a means of stamping a time card it was a howling success. Why! even with the figures in plain view on the card most of the men couldn't get the hang of how to sum it up. It therefore remained a thing of mystery and a nine-days' wonder.

To a casual onlooker it appeared as if wonders were never to cease, for there appeared in rapid succession many innovations. In fact some of the men considered it as good as a vaudeville performance, but "Old Ben" in the tool room said it was more like a three-ring circus, and that while you took in an act in one ring you missed something in another. Of course, this levity on the part of some of the employees was all unwarranted and most certainly in bad taste, for was not the firm spending good money in this campaign of education? And were not the men the ones benefited by the night lectures, etc., designed to make them acquainted with the many wonderful things by which they were environed?

Nevertheless there was a grain of truth in "Old Ben's" statement, for the men

"IN THAT TOWN THERE USED TO BE A VARIETY OF CALLOW YOUTHS"

had scarcely gotten themselves equipped with Ingersolls to overcome the clock difficulty when speeds and feeds were sprung upon them. Close upon the heels of this and following in rapid succession came tickets of instruction as to setting up the machine, the operations to be performed, etc., on each part; requisitions for stock, each variety being designated by a lengthy aggregation of letters termed a symbol; new tools of all conceivable forms, one of each type being for steel, cast iron, or brass, each to be called for by its proper symbolical designation; numbering and lettering of all machines in the shop; rearranging of their countershafts to suit new speeds; assigning letters to each department by which they were afterward to be recognized; routing of work from one machine or one department to another; new forms of stationery, some of which had to be printed in Europe because of the size and complicated ruling; charging of everything to a symbol, the 1000-page book explaining these symbols, and the heated arguments which frequently arose over these charges, especially when it was an expense or reclamation charge against a department; continuous balance of stores; and, in the language of an auction advertisement, "many other things too numerous to mention."

In that town there used to be a variety of callow youths who could generally be seen of an afternoon on a corner, a cigarette or pipe and red necktie being quite common accompaniments. They were willing to work but had no trade, besides most trades were so dirty and ungenteel. Well, after Brown got the system going they found employment in the planning department, stock room, etc. And thus was Brown a public benefactor without being cognizant of the fact, which reminds one of the old saw, "It's an ill wind blows no one good luck." But this is a digression. Let us see what has become of Smith.

Smith Places an Order with the Manufacturing Establishment

About this time Smith took in a job and discovered after getting the casting that, in consequence of a boss on the side it was too large for his boring mill. He called up the "manufacturing establishment," and after talking to the telephone boy five minutes and about one minute each to 10 other persons, finally got Brown himself; after which ensued the following conversation:

Smith. "Have you a boring mill that will swing 10 feet 4 inches?"

Brown. "Our *B*1 is 10 feet; can quickly find out if it swings more." (Presses button and as boy comes calls out, "Boy, get No. 76.")

S. "How's that?"

B. "Oh! No. 76 is our chief router on boring-mill work."

S. "Do you call your men by number?"

B. "Well, not exactly. You see we have had several men in this position in the course of the past year. I don't remember all their names but the number is always 76 for that particular job. The number is really the designation of the position and not of the man who fills it."

S. "How do you remember the number?"

B. "Oh! That's easy! I have a list of all positions, the duties of each and the number assigned to the man occupying it. Some I can remember, those I cannot I refer to the list. Yes, Mr. Smith, B1 swings 10 feet 5½ inches. Seventy-six tells me it normally only handled 10 feet 4 inches but that they chipped ¾ inch off each housing thereby increasing the capacity and along with it the rating and permanent value of the machine. The rating was increased two cents per hour. You see that means about $60 per year to us."

S. "Yes, it means two cents an hour more I'll have to pay if you take the job, wish you hadn't chipped those corners off." (Proceeds to explain what the job is and winds up by asking what it will cost and how soon he can get it.) Brown explains that it is not within his province to fix a price or assign a shipping date, the former function belonging to the contract depart-

FORM DPVIQ - 9 F 07

DATE 4 Ja 08

INTER OFFICE CORRESPONDENCE

FROM DEPARTMENT M

TO DEPARTMENT DC TO MAN NO. 100

DEAR SIR: Please enter a contract No. for machining one casting for John Smith, City. Casting will be delivered here and called for when finished. Have agreed to charge cost plus usual percentage of profit. Came unsolicited; no agency allowances.

SINCERELY, MAN NO. Jas. Brown

American Machinist, N.Y.

BROWN "WRITES TO MAN NO. 100"

ment, while the chief production clerk would have to be consulted in regard to the latter but, nevertheless, if Smith would send the job over, would do the best they could for him, charging cost plus the usual percentage of profit. Smith finally agrees to this and tells his driver to take the casting over and leave it there.

While Smith is instructing his driver Brown procures a pad of "inter-office correspondence" and writes to man No. 100. Then he wrote a note for the tickler file. After putting the above in the inter-office mail box he forgets the matter.

Smith's Driver Delivers a Casting

In the meantime Murphy delivers the casting and reports to Smith: "Sure, it's a blithering lot of idiots over the strate there is Mr. Smith and it's mesilf that ached to split the skulls of a bunch of thim. 'Twas just noon whin I drove into their yard with the casting and divil a bit did they want it. Sure, some fresh young guy they called their recaving clurk said he had no bill of material, for anything uv the sort and he couldn't take it in unless he had some authority fur doing uv the same and a tag to put on it telling its history and final distination. Sure, I had a divil of a toime argufying with them until I foinally got me temper up and unloaded it mesilf. I made free to use their yard crane for the purpose but I believe they were all too anxious to get in and punch that two-faced clock to care a bit what happened, for not a man was in sight when I unloaded. Sure, you said to lave it there and begorra I did, but just spake the word and its mesilf will be glad to go and take it away again frum the numsculls."

The foregoing rather amused Smith and also excited his natural curiosity. He decided to slip quietly over on Wednesday for the ostensible purpose of seeing his job, which he figured would be about finished by that time, but in reality to see for himself some of the strange things he had heard of. So on Wednesday he left word with his boy where he could be found if needed and started out for a tour of inspection.

Now, there was a sort of a telegraphic or telephonic system of communication in

"LOOKS LIKE THE STOCK EXCHANGE"

FORM DPT. 3 Q - 10 JE 07

TICKLER.

FROM DEPT. M

DATE ENTERED 4 Ja 08

DATES TO COME OUT TO DEPARTMENT PP | 6 Ja 08 | | | | |

MAN NO. 65

PLEASE REPORT ON THE BACK OF THIS TICKLER TO THE UNDERSIGNED IN REFERENCE TO time of delivery on one large casting to be machined on B I for John Smith, City. Send boy over for dwg when needed.

SINCERELY, MAN NO. Jas Brown

American Machinist, N.Y.

BROWN'S NOTE FOR THE TICKLER FILE

Smith's shop and he had not been out five minutes before every man knew that "the boss had gone over to see the two-faced clock." Many and varied were the guesses as to what would impress him most, and it was decided that some one of them should, at the first favorable opportunity, quiz him and pass the answer along; for, be it known, some shops are as bad as a sewing circle. In the present case we must make haste to catch up with Smith who has passed the gauntlet of the head doorkeeper and been given in tow to a young man for a tour of inspection.

Smith Visits the Manufacturing Establishment

S. "Well, young man, what's your official position here?"

Y. M. "Oh! I'm understudy to the second-assistant cost accountant."

S. "Got a number?"

Y. M. "Sure! I'm 503."

S. "You seem to have a high number."

503. "All the cost accountants are in the five-hundred series. The chief is 500, first assistant 501, second assistant 502, his understudy (that's me) 503. When 502 is absent I'm 502. You see it's so arranged we're always in line for promotion. Why, when I first came here I was just an ordinary stenographer."

S. "What's that bunch of noisy boys over by the long bench doing? Looks like the Stock Exchange."

503. "Oh! Those are the call boys. The annunciator shows that a boy is wanted for an errand in department P P and they're arguing whose turn it is. You see, every six months the boy who has answered the most calls is promoted to the next highest position."

(Pass into a department.)

S. "What do all these fellows here do?"

503. "This is D D C, the department of design and checking."

S. "They don't seem to be making drawings."

503. "No, they criticize the designs after they are completed and return them to the drawing room for the necessary corrections."

S. "That must be an easy job. Most anyone can criticize."

503. "Well, besides that they check the drawings after the first preliminary corrections are made to see if they go together all right. They are then returned to the drawing room the second time for correction, after which they come back to D D C again and are compared to see that all changes are made."

S. "Where do they go then?"

503. "They are then approved by the chief supervisor of design and sent to the photographic department to be printed."

S. "It must delay the work considerably, but I suppose they go to the shop then and they hustle the job out quick."

503. "Not so fast. They then go to this next department D B M or department of bills of material. These men get the complete set of prints for a job direct from the blueprint room and write the bills of material."

S. "But I noticed back in the other room that the general drawings had a bill of material on them."

503. "That's only a list of parts. The bills of material these fellows write tell the size of stock to make parts from, how big to core out holes that have to be bored or whether to drill from the solid, what size hubs to put on wheel patterns to make the casting like the drawing and lots of other things I don't know anything about."

S. "Can't the patternmaker see the sizes for hubs on the drawing?"

503. "You see the pattern shop only gets drawings for new patterns. The second time a wheel is cast the hubs may not be like the drawing first showed them. He has nothing to do with work from old patterns unless they require changing. The man who takes patterns from the storage shed selects hubs to agree with the order written out by the order clerk. The clerk copies this from the bill of material. The bill is written to agree with the drawing."

Smith Learns of the Book of Rules

S. "What does this H C B 4 X 2 mean on this item of a gear wheel?"

(Boy, No. 610, writing the bill) "That means hub, cope side, 4 inches diameter by 2 inches long."

S. "How do you know in the office which is the cope side?"

610. "One side of the pattern is marked cope and the other side drag. I don't know what cope and drag mean but rule No. 47 says, 'In ordering spur gears with cast teeth make the cope side of the gear mesh with the drag side of the pinion' and rule 48 says, 'gears with clutch jaws cast on the hub put the jaws on the drag side,' I don't know why but them's the rules."

S. "From the size of your book of rules you must take it home nights to study it."

610. "Nope. Not allowed to take it outside the works and the guy from the vault gobbles it up every evening about ten minutes before whistle time.

S. "What do you do for those ten minutes if you want a rule you can't remember?"

610. "Ah! quit your kiddin', the boss's lookin'."

As they are leaving the department Smith pauses at the desk of an older man writing bills and asks, "How can you order the right stock for a difficult forging?" The man replies, "Opposite items of such form that it is difficult to order the proper sizes we stamp D F Sub Req. which means, department of forging issue sub requisition for the necessary stock. This gives the blacksmith authority to get whatever stock is required for the job."

As they move on Smith makes mental note that a visit to the pattern and forge shops would be of interest.

503. "This is B S C, balance of stores clerk."

S. "What are your duties?"

B. S. C. "I fill in this column on the bill of material which gives the symbol of the proper variety and size of stores which the workman is to draw from stock and use in making the part."

S. "Suppose you don't have the proper size on hand?"

B.S.C. "Then I mark it P which means purchase."

S. "How do you know whether you have enough stock of that size to do the job?"

B. S. C. "Every time I assign a piece to a job I note it in this column and when any is turned into stock it is noted in this other column. I can always strike a balance and tell what is left. When any size gets to a certain minimum amount on hand I order the amount necessary to put it to the maximum."

S. "You pay no attention to market?"

B. S. C. "No, only to demand."

S. "Market is generally high when demand is great so you must pay steep prices."

B. S. C. "That's the lookout of the purchasing department to keep prices down; I've enough to do to record all these symbols and keep my balances."

S. "I notice on this list the balance on hand is less than the amount marked as the minimum."

B. S. C. (in confidential tone) "You see this is early in January and the systematizers wanted to help their yearly report along so had me hold back orders for stock until about the tenth of the month, then to commence to send them in gradually."

Smith Sees a Few Purchasing Department Methods

S. (to 503) "Where is the purchasing department?"

503. "Oh! it's in the front office but here comes the second assistant now."

(Second assistant stops at B. of S. C.'s desk and opens up on him.)

"You guys in here think you're smart don't you? Put a tickler into the chief to know why those angle irons wasn't in when you had put the order in two weeks ago. Guess you don't know the difference between a standard and special section. The mills may not roll that size again for a month, and, anyway, you fellows in here think we can get the same consideration and deliveries out of the big steel companies with our little drib orders that other companies who order in quantity can. Ah! you make me sick!"

B. S. C. "Oh, I don't know. How about those six hundred 1⅝-inch stud bolts? I marked those P opposite the size of stock required and you thought you were real bright and saving the company money by buying them already threaded. In the meantime the shop finds enough stock ordered for another purpose and thinking it to be what you were supposed to order for this job cut them off and threaded them. Now we have 1200 and can only use 600. To make it worse they're an odd size. Oh, you'd better stay out where you belong and not come throwing hot air at me, I'm busy."

S. to 503. "Suppose we go out in the shop and let these two fight it out undisturbed?"

503. "All right, but you missed the slide-rule men, who figure out feeds, speeds, machine time, etc.; the adding-machine manipulators who help on keeping costs; the routers who course the material through the shop, the recorders who mark up the condition of the work from time cards, and Oh! just lots of things you haven't even noticed here."

S. "No doubt, but the air's bad and I want to see how it works in the shop."

(Pass into the shipping room). Smith knows one of the shippers, a sort of

windy pessimist, and asks how things are coming.

Shipper. "Fierce! Rotten! Wish I was back in the oil country."

S. "What seems to be the trouble?"

Shipper. "Most everything's trouble around this lease. See those blank bolts there, for instance. This bill of material calls for so many bolts, but what good are they without any thread or nuts? I sent a boy into the storeroom for ones with thread on, but he didn't have them, and said he couldn't give them if he had for the symbol meant blank bolts. Next I sent to the gang boss over bolt threaders and such like to know why they hadn't been threaded and he said he hadn't any ticket for doing it and I'd have to see the man who issued work tickets. Well, I went to him, but he couldn't see why he should issue any ticket for a bolt when it was marked stock and consigned to the shipping room and if I wanted any work done on it I'd have to get the bill of material changed to send it to the machine shop instead of shipping room. So I went to the departmental clerk, who puts these letters on our bills telling which department the part drawn from stock is to go to and asked him why he didn't send those bolts to the machine shop instead of the shipping room. He couldn't see why he should send them to the machine shop for the bill of material said in the column headed 'Where Used,' 'in foundation' and he couldn't see what use the machine shop could have for foundation bolts. He said it was the man in the field who wanted them. Now I knew blamed well the erecter wanted them, for the production clerk was out here two days ago with a letter from him and raised Cain with me about it. Said the erecter had a gang of laborers waiting on those bolts, and if he didn't soon get them he'd put in the foundations without bolts and then drill holes and use expansion bolts, maybe they could get them to him sooner. I told this to the departmental clerk and certainly thought I'd explained it fully, but the darned fool wanted to know why I didn't send them then, that he wasn't running the shipping room. Then I brought him out here and showed him the bolts and explained that a bolt wasn't a bolt really, until it had some thread and a nut on it. Then he tumbled, but couldn't see how he was to know it was a blank bolt, he couldn't remember all those symbols the store's clerk put on the bill and that even if he had consigned it to the machine shop the route clerk would probably have sent it to the erecting floor instead of understanding that it had to be threaded.

"Well, I finally got the clerk to make out the proper tickets, but don't know what became of them. Suppose they are at the bottom of the board waiting their turn. You see neither the route clerk nor I had authority to say that they would take precedence over other work, so there they lie, tag and all. About tomorrow I expect the production clerk will be around and raise a howl about them, after which he'll go and advance the ticket to the top of the board; then in an hour or so a laborer will come along with the 10-ton traveler and a tote box weighing about a ton, load half of them in and carry the other half to show he's working. A few hours later I can go down and see them threaded and an hour or so more and they'll be delivered to me. Oh, no! That don't end my trouble. I'll bet a $10 dog there won't be any nuts on 'em. I'll have to make out an order for the nuts, get it signed by the machine boss and stamped by the general storekeeper, then send a boy to the storeroom for them and, if in luck, can get them inside an hour. I'll then try one on and if it goes on freely O. K.; if it goes on very hard, I'll have to start all over again to get the die readjusted and run over once more. Say, Smith, don't you want a handy man over at your place?"

S. "You used to be a pretty good man in the oil country, but I'm afraid the luxuries here have spoiled you; at any rate I don't want to take any of Brown's men away from him."

(Shipper heaves a big sigh and looks regretfully after them as they move away.)

Smith Visits the Stock Yard

503. "This is part of our stock yard."

S. "What does that sign SVU6Q mean?"

503. "That is one of the symbols which designates the different sizes and varieties of stock. Those are the ones that balance-of-stores-clerk you talked to was putting on the bill of material."

S. "Yes, I surmised as much, but what does it mean? What do the letters stand for?"

503. "Oh! S means that it is stores of some sort, the V means that it is for a variety of purposes and that's all that I or anyone else can remember about it excepting that the U, 6 and Q designate that particular size and variety."

S. "So the last three letters really tell what it is, but no one remembers what they are because there are so many of them. Now why not drop the S V since they all seem to be S V, then one might have some chance; at any rate, it'd be shorter?"

503. "We have some stores which are only for one specific purpose; they have the S as a prefix, but the second letter changes."

S. "Couldn't the S be dropped, then?"

503. "No, that distinguishes them from worked material which is W."

S. (Producing a pencil and notebook.) "You may be right, but I write it 1"o, meaning 1 inch round; this other pile is 1" □, meaning 1 inch square, and again these angles I write 4x3x⅜ L, and anyone who ever heard of an angle iron knows what that is."

503. "Why, that's funny; I could remember those sort of symbols easily, but I'm afraid they couldn't write those on the typewriter."

S. "Well, suppose you used Rd. for round, Sq. for square, a capital L for L, or even Ang. for angle; couldn't you understand that?"

503. "Sure, anyone could, but it's too easy, that's the trouble. You see our systematizers have made a special study of the subject; why, I've heard two of the lectures entirely devoted to symbols and I can't take it all in yet. Oh! it's a grand scheme when you hear them tell it, all mixed up with cost system, etc."

(Pass into machine shop and Smith stops at gear cutter.)

Smith Interviews a Gear Cutter and Planer Hand

S. (To operator.) "How long do you think the machine will last the way you're running it?"

Operator. "Don't know and don't care a ———; them's the speeds and feeds given me and so long as it makes a tooth it isn't my funeral."

S. "But B. & S. gear cutters cost money."

Operator. "Sure thing they do. Maybe they figure there's going to be a new model out in a couple of years and want to put this one on the blink by that time. See that gang over by the keyseater? Well, that's the third cutter bar they've bunged up in two weeks, but it's not charged up against the job. Oh, no." (Gives a broad grin as Smith and 503 move on and stop at a planer.)

S. "You seem to be running at quite a moderate speed."

Planer Hand. "Say, you don't belong to this concern, do you?"

S. "No; why?"

P. H. "Knew you didn't. None of them can tell by the looks of it anything about a speed. They've got speed indicators, etc., when they test a machine."

S. "Seems funny they don't speed you up, then."

P. H. "Well, I'll tell you how it happened. I put rosin on the belt so it squealed and they couldn't speed it up. Yes, I notice you looking at the casting in the machine and the pile on the floor, but don't say a word! You see, if I put six on the table at once I could make a whole lot better time, but in the end I'd work harder and get less for it; besides, the fixture only holds one. I'll wait until after the rate is thoroughly settled for these pieces, then work the rosin off the belt and gradually speed up. Maybe I won't earn my bonus good and plenty for awhile. When they cut the rate I'll kick, but finally after the new rate is settled I'll put six on at a crack and make another haul until they get next to that. When the place gets so I can't work them I'll look for another shop where they're putting in system and have a good thing there for awhile. Oh! there's nothing like

system. All you've got to do is keep your head under your cap, wait awhile each time, then throw the hooks into 'em good and plenty. The more system the merrier, only I don't stay for the finish, see!"

S. "Why don't you turn systematizer yourself and concoct a scheme the men can't beat?"

P. H. "I'm not smooth enough for that job, anyway it can't be done. Most of these systems I've bumped into seem to have for their object the making of a mere machine out of the shop man. They try to have someone else do the thinking for him and treat him as if he was a part of the machine. That's why I jab the harpoon into 'em. I did turn systematizer once long enough to write a recipe which was something like this: Select equal parts of young fellows from the high school, business college, Y. M. C. A., and correspondence schools, add one desk to each, mix up with plenty of printed forms, time cards, slide rules, adding machines, time clocks and typewriters, garnish with symbols and serve bound with red tape."

"THEY HAVE THE NERVE TO TELL THE OWNER THEY'RE SAVING MONEY FOR HIM"

S. "You seem to have it down fine."

P. H. "Sure! I've studied the thing from the owner's side of the question too, and it figures out this way: System wants to pay me for running this planer, that's all they they expect of me, they hire a $12 clerk to do my thinking. Well, I've got the same old brains I had before the system and they've got to pay me as much as ever, whether I use those brains or not. System says it is centralization of management, concentrating the brains in one department. But, *before* the system was installed they had a certain amount of brains in the shop and *a job cost* $20; 'after taking' they have *the same brains* in the shop *plus an additional amount* in the concentrating department and *the job costs* $25. Yet they have the nerve to tell the owner they're saving money for him because the shop work on the job used to cost $20 and now it costs only $18. You can bet they don't tell him that the new high-speed steel or a new fixture saved the $2 and that $7 was expended in maintaining this army of clerks who write out orders to the shop man how to do his work and then figure up after him what it cost. You see their time isn't charged to the job, it goes in on the overhead charges; sort of looks like profit when you're tagging it onto a price, but it isn't.

"How'd you like to pay for a piece of bench work done in a shop where they valued their floor space at $5 a square foot, had about one clerk to every three or four men in the shop, had the tool room full of all kinds of conceivable tools and fixtures, the storeroom full of all sorts of stores (much of it dead stock) and paid the interest on the money invested in all this stuff, as well as the clerks' salaries, by an overhead charge?"

S. "Wouldn't do it. I'd send the job to a man who didn't place any especial value on his floor space and whose office force consisted of a bookkeeper and time clerk."

P. H. "You've got the idea O. K."

S. "What is your version of a well-managed shop?"

P. H. "Why, a shop where you wouldn't have to beat the system because there wouldn't be any except that each man was expected to do a full day's work for a full day's wages, and do his own thinking. At any rate that would suit me."

Smith Gets Initiated into Pattern Symbols

(Now, to be realistic, at this point an officious underling should come up and inform Smith that it was against the rules to talk to employees during working hours; but as this would stop the story, leaving Smith's visit uncompleted, we will follow Smith to the pattern storage where 503 has led him.)

S. "This seems to me an odd way of storing patterns. Now on this one shelf there are a couple of housings or frames, four gear wheels, five bearing caps, three bushings, four levers and an assortment of miscellaneous parts. This pattern here looks like a connecting-rod brass while on the floor under the shelf are several large parts, one evidently a base plate of some sort; on the next shelf is a somewhat similar collection. I should think you'd have all gears together, bushings all in one place, bearing caps collected on one shelf, etc. Then if you wanted a bushing or bearing cap you'd know just where to look for it. I've got my patterns arranged that way and when the draftsmen can't find a drawing or pattern number of a cap or bushing and is making a new one I walk him over to the pattern shop and show him one that just fits. Next time he goes himself. Of course, it generally isn't necessary to do that as I have all caps, bushings, gears, etc., indexed so you can find them, but it often helps a lot to see the pattern, see how it's made, etc. Sometimes it is easier to change a pattern than one would think from looking at the drawing; again the reverse is often true."

503. "That sounds good but the scheme here is to keep all the patterns together for one machine. You see we assign a symbol to each machine we build. The first letter of the symbol designates the general class to which the machine belongs; thus all engines are E, boilers are B, cranes are C, presses are P, etc. The second character represents the size, A being the smallest size, B the next and so on. The third character is the design number. A is the first design gotten out for any particular size, B the next design of that same size; it may be an improvement over the first in some respects or of an entirely different type but for the same purpose and of the same capacity: that is, the same size. The fourth character is a numeral and is the piece number while the last letter designates the group to which the piece belongs.

"This gear wheel is P B A 6 C the P means press, the B that it is the second size in the series, the A that it is the first design of that size gotten out, the C that the part belongs to the cam group and the 6 that it is the sixth piece in the group. Now if you drop the 6 out we have left P B A C which is the symbol of the complete cam group and all fitting work of one part to another, to form that group, is charged to the group symbol. By dropping the C we have P B A which is the symbol of the entire or completed machine and all assembly of one group to another on the erecting floor is charged to the machine symbol. Thus fitting the cone

to the shaft is charged to P B A C and putting the shaft in place on the machine is charged to P B A while the machine time on the gear which goes on the shaft is charged to P B A 6 C. Sometimes in our department we carry the eliminating process still farther and drop the A when we have P B, which means all presses of that size and again by dropping the B we have P, which designates all presses irrespective of size or design.

"To get back to the patterns and our method of finding them, this grand group of shelves is P and contains all patterns for presses. It is divided into several groups; this particular one is B, or the second size of press. They could be further separated as per design and group and in fact this is done when necessary; most cases, however, can be stored without this extra subdivision."

S. "You seem to have quite an elaborate system but here is a bearing cap P B A 10 B and across the aisle is one which seems exactly like it but is marked E C D 3 H. How do you account for that?"

503. "You see the one belongs to a press while the other is for an engine; I suppose they just happened to be so near alike. Probably the same man made the drawings."

S. "They should have used the same pattern for both machines but I can see by your system of symbols that no one would know where to find a cap of a certain size unless he knew the symbol or had some sort of cross-index scheme, and it seems natural that when the draftsman makes drawings for an engine he would never think of looking through presses to find a bearing cap. At any rate it is much quicker for him to make a new detail than hunt up an old one."

503. "Guess you're right there for I've heard the draftsmen kicking about the chief wanting them to look up old patterns. They say he wants the job in a hurry and they can't take time to go all through the records trying to find a little part so they make one to suit the job."

SMITH TALKS WITH A PATTERNMAKER

(S. and 503 move on to the pattern shop and stop at a bench where the patternmaker is nailing on the strips which are afterward to become the teeth of a spur gear.)

S. "You couldn't make any gear patterns for me unless you put the teeth on with screws."

Patternmaker. "Well, I'm only allowed so much time on the ticket in which to make the pattern if I'm to get the high rate. Of course, I won't get the low rate if I can help it. When the time is less than necessary to make a good pattern I throw it together and paint on the fillets. You see we use black shellac and it covers a multitude of sins."

THE BOSS "RAISED A HOWL ON THE TIME ALLOWANCE"

S. "Don't the boss kick?"

P. M. "How can he? He knows I can make a good pattern when I have the time allowed but since the system he's only a sort of checker to measure up, see that the pattern will draw out properly, hand out tickets and interpret difficult drawings. Now, before the system was applied to the pattern shop he planned the work in advance and divided the patterns into four classes, standard or much-used patterns, semi-standard, occasionally used patterns and special or one-job patterns. We made the patterns accordingly. Now he is not supposed to ask questions but saw wood. A clerk writes him his orders and he obeys them. Tried a few times to get things changed when in his judgment they should be different but he's no diplomat and failed to convince them of the errors of their ways. Seems the result is he was practically told to mind his own business and obey instructions."

S. "I noticed as I came through the pattern shed several cases where patterns on one shelf looked to be nearly duplicates of ones on another shelf but having entirely different symbols. Now, in my shop I certainly would not make a new pattern if an old one would answer the purpose, even if I had to change it some."

P. M. "There's several reasons for the condition you mention existing here. One of the reasons I can best explain by telling you a little joke we played on them when they first put us on the bonus system.

"After rates had gotten pretty well settled and we had become used to the new symbols, some of us discovered that we were frequently making patterns nearly duplicates of ones we already had. So when we got such a part we took the old pattern, if not a standard one, and changed it to conform to the drawing, keeping a record of its old and new marks so if it was ever called for again we would know what became of it and transform it back. Well, it worked fine for awhile and maybe we didn't make big pay some weeks; but we couldn't beat the clock, and after awhile they commenced to send out tickets with time based on one of these jobs, and, not being in the secret, they didn't know that we never really made a pattern for that particular part, but just changed the symbol on an old one, put a piece or two in the core box, stopped off a projecting lug, gave it a fresh coat of shellac and sent it out. So it happened that the joke commenced to work on us and the boss went in and raised a howl on the time allowed. Then they showed him the time cards on a job very much like it which sort of took the wind out of his sails. Don't know just what was said, but they must have had it hot and heavy, for when the boss came back he was mad clear through. We got orders to make a new pattern for every new symbol, even if the man on the next bench was making another so near like it you couldn't tell the difference; also that if the time allowed was sufficient to make a first-class pattern we'd make it so, if not, make it as good as we could in the time allowed. You see we get our castings outside so they don't get any time cards from the molder, and if time allowance on a pattern is short we make it cheap, even if it is expensive to mold."

S. "How do you like the scheme of ordering hubs?"

P. M. "Oh, that's all right. We don't have anything to do with it. The foundry or casting clerk has a laborer get out the pattern and put the hubs on. We don't even see the pattern."

S. "But don't the laborer get the hubs wrong sometimes?"

P. M. "Sure he does, but the foundry

has a copy of the order and sometimes catches an error before casting and sends back for the right hubs. That only means a loss of time, especially if we don't happen to have the right size and have to make them. Of course they get wheels in wrong, but don't always have to scrap them. Machine shop generally fixes it up. Keep a lot of bushings and collars on hand just on purpose. Oh, as far as we're concerned it's fine, for it relieves us of a lot of trouble."

S. "When they have to scrap a casting on account of wrong hubs, or something like that, what do they charge it to?"

P. M. "There's been a fierce fight over that. First, there's the drawing room, next the bill-of-material department, then the purchasing department copies the order, then the foundry clerk, then the laborer who gets out the pattern, next the driver in delivery may mix the hubs, and finally the molder may make a mistake. Sometimes you can saddle the bull onto some one of them, but it costs more than the casting's worth to do it."

Smith Visits the Blacksmith Shop

(Move on to forge shop and Smith observes a large heap of short pieces of round iron in a corner and asks what they are for.)

Blacksmith. "Dem ish bosses vat de man vot writes de orders tinks ve veld to de levers ve makes."

S. "You didn't jump the bosses on then?"

Bla. "Nay! Nay! Ve draw dem oud so." (←■ ■→)

S. "And that other heap of miscellaneous flats, rounds, etc.?"

Bla. "Dem is some more of de foolishness of dose fellows vat writes de sdock orders. Dey generally vas too shord cut off. Ve no dam fools be. Ve makes de ting any vays ve best can do him."

S. "Why don't you scrap this stuff?"

Bla. "It vas good sdock, maby sometimes ve use it for somedings else. Pretty soon ve all sizes haf in dat heap. Den ve no more need go to sdock yard."

S. "Some of your orders are stamped for you to get the stock."

Bla. "Sure! Ve den our own sdock can get, und ven it is not so sdamped ve generally gits him anyvays."

S. "How's that?"

Bla. "Vy, we first a search make in de pile, und if ve can't get him dere ve orders him along mit one of those udder parts vich is sdamped."

Smith Finds His Casting

Just at this juncture Smith catches a glimpse of a casting which looks suspiciously like his job and goes to investigate. Sure enough, there it is, and a receiving clerk is just attaching a tag to it.

S. "Suppose that tag means that the job is going to be hustled through now?"

R. C. "Not necessarily so. It simply means that I've just got the bill of material which notifies me that such a casting is coming in. This is the route ticket, which tells the course of the casting through the shop."

S. "Does the ticket tell when the job is to be finished?"

R. C. "No. The bill of material should tell the shipping date, but in this case it is not filled in."

S. "I sent that casting over Saturday, now its Wednesday. I expected to see it nearly finished. Here it's not even started yet. Lord only knows when I'll get it at that rate."

R. C. "Why, I've just now received the bill of material and route card; you're in luck it's that far along. It takes time to get a job started here. It may not be rated yet. I'll call up the machine shop and see if the work ticket is out."

The receiving clerk returns, after telephoning, with the information that the ticket has just come out and is near the bottom of the board. He advises Smith that if in a hurry for it he'd better see the production clerk. So Smith looks around for 503 and gets him to pilot the way to that important personage where

"SUPPOSE THAT TAG MEANS THAT THE JOB IS GOING TO BE HUSTLED THROUGH NOW?"

he states his case. The production clerk cannot see his way clear to advancing the ticket at first on account of other work, but finally agrees to put it half way to the top, which would mean four or five days instead of about eight.

Actually in six days Smith got it and found it O. K., but they had furnished four brass bushings which he had not intended them to furnish, but as he was able to cancel his own order to the foundry for these bushings in time to stop their being cast, said nothing, but 'phoned to Brown to send in his bill, to which Brown replied that it would take the usual course through the cost and contract departments and in due course of time arrive.

Smith Gets His Bill

Well, it was about 30 days before it finally did arrive, and caused Smith to open his eyes. Long before he had gotten tired of waiting and had estimated the cost, added a profit and sent in his bill for the whole job and had the money in the bank drawing interest; but it seemed he had woefully underestimated the part sent to the "manufacturing establishment." He went over the job carefully again, including material and labor on the four bushings, but still it was way lower than the bill, so he 'phoned over and asked for a detailed bill. This came along in a couple of days, and after looking it over and making allowance for the large overhead charge they must necessarily have, it was not excessively high excepting the item of bushings. The lathe time on these was about three times what it would be in Smith's shop and the price for material simply outrageous.

Now, Smith knew where they got their brass castings and knew what they charged him per pound. The finished size of these bushings was 5½ inches outside diameter, ½ inch thick by 8 inches long. Smith had allowed ⅛ inch finish, and figured them to weigh 30 pounds each, and at 28 cents per pound the cost to be $8.40 each, or $33.60 for the four, whereas they were billed at $30 each, or $120 for the four for material alone. So he called up and told them he would accept the bill if they rectified the items on bushings; that these were ordinary bearing bronze, not gold, and he couldn't afford to pay $120 for them. Well, Brown got 502 to investigate, who discovered that the balance-of-stores clerk had put a symbol opposite the bushings which meant that certain stock bushings were to be used. These stock bushings he found to be 7 inches outside diameter, 12 inches long, and cored out to 3 inches; the ticket gave the weight as 100 pounds each. The price was based upon 30 cents per pound, which figured $120 for the four.

Brown calls up Smith and gives him the sizes and weights and wants to know what's wrong about it. Smith tells him he wouldn't object to 30 cents a pound but that they should weigh only 30 pounds in the rough each, and that if he wants to dispose of any old stock all right, but to charge the customer for what he gets, not for the piece left over and all the extra chips. Brown acknowledged that the 4 inches cut off the end should have been returned to the storeroom and credited to the job instead of being scrapped, but regarding the extra finish he claimed that Smith was in a hurry and they were justified in using any stock bushing that would finish to size. Smith acknowledged he was in a hurry for the job, but that it was about 10 days before he got it, which gave plenty of time to have cast bushings of the proper size, and at any rate they would realize a fair value on the chips in scrap returns, as he figured the finished bushing to weigh about 19 pounds, leaving 81 pounds for chips and the piece cut off of each, and if one pound was lost there still should be 80 pounds left to sell. Brown thinks over this a minute and then concedes that the case is rather unusual, and, since these bushings were dead stock on their hands, he proposes to take the rough weight of the proper size bushing at 30 pounds, leaving a difference of 70 pounds extra finish, and credit Smith with

this amount of scrap each at current rates, but maintains that the lathe time should remain as billed for, if they had actually made a pattern in order to leave the proper finish, Smith would have had to pay for the pattern.

By this time Smith has lost patience and considers that the argument has reached that stage where forbearance has ceased to be a virtue, so he opens up to relieve his mind of long-pent-up ideas, in the process of which he informs Brown, among other things, that he didn't ask them to furnish the bushings in the first place, that he had only managed through the slowness of his own clerk in ordering them to be able to

THE APPRENTICE BOY ADDED D F

cancel the order in time to stop pouring. that he figured on ⅛ inch finish and 28 cents a pound; at that rate the bushings should cost only $8.40 each, that he had a pattern and wouldn't pay any more for them, and that he furthermore did not intend to pay for the lathe time in cutting off the extra finish, that in his shop it would have cost only one-third what they charged for lathe time and that if they cut the lathe time in half and charged $8.40 each for material he'd pay the bill; if not he'd force them out and return them, paying for the balance as itemized and you could bet your sweet life he'd send no more jobs to them.

He took occasion to remind them that in his estimation the rest of the bill was much too high on account of the overhead charge they had evidently added, and that if he ever installed a system he'd have enough horse sense to kick the systematizers out after he had the main ideas in good shape, that no one ever heard of a systematizer being satisfied that the job was finished, that if you kept them on they'd bankrupt you. He gave it as his opinion that the only thing which saved most idealists with the system bug in their heads from being bankrupts was either a board of directors or else the systematizers found fatter picking elsewhere and regretfully migrated of their own accord. He advised Brown to get on a pair of cowhide boots and start in the cleaning-out process right away, then to hire a good *desystematizer* to get things on a practical basis.

Smith Sizes Up Brown

After thus relieving his mind he hung up the 'phone with a snap and went out in the shop to cool off. The reaction brought a thoughtful frame of mind and, under inspiration of a suddenly acquired idea, he marked on a post this conglomeration of letters:

U S S E W H N A U S B S B T M E 1 B.

Several of the men came to see what was new and asked what it meant. "Well," said Smith, "Some of you fellows tried to get my ideas in relation to system last month after I had paid a visit to Brown's place, but guess you didn't succeed very well. Oh, I got some ideas over there all right and this is one of them. This collection of letters in Brown's symbol in the way he would be identified if one of these abtruse-minded theorists labeled him. It means: Universe, Solar System, Earth, Western Hemisphere, North America, United States, Blank State, Blank Town, Manufacturing Establishment, First Brown." One of the apprentice boys climbs up on a stool and adds D F, which caused a general laugh and incidentally won him promotion the next week.

The department of chemical engineering at the University of Wisconsin has been carrying on an extensive series of tests of the various methods for measuring the heating values of gas, in order to enable the State Railroad Commission to determine a standard gas for fuel and illuminating purposes. The calorimeters of various types made both in this country and abroad and used to test the heating values of gas have been thoroughly tested. It was discovered that one type of instrument extensively used and sold gave heating values from 10 to 20 per cent. higher than the gases measured actually contained, and that erroneous results were being obtained in gas-producer and gas-engine work where these instruments were found in use. Investigation work along this line is to be continued, and the chemical engineering department is coöperating with the railroad commission and the committee of the American Gas Institute in prosecuting this research work.

A Revolution in Steam Boiler Practice Foreshadowed

On pages 284 and 285, Volume 31, Part 2, we reviewed Bulletin No. 325 of the United States Geological Survey. We there suggested that some of the results pointed to a great possible improvement in the operation of steam boilers and quoted certain paragraphs bearing on that point. One of those paragraphs reads: "*Boilers*—The authors see no reason why boilers cannot be constructed and properly operated with entire satisfaction which will produce about 10 times the amount of steam now obtained per square foot of heating surface and with no difficulty in maintaining dry steam. The efficiency from dry coal to steam should easily be made considerably higher than that of a good performance of today. Such a plant would require only a fraction of the present investment in steam plant, building and real estate. Perry states in his book, 'The Steam Engine, Gas and Oil Engine,' that he thinks boilers should be made to do 10 and possibly 20 times the work they do at present."

A recent paper by Doctor Nicolson, printed in *Engineering*, of London, records the results of extensive experiments on heat transmission through boiler plates and presents as striking conclusions as those contained in the bulletin to which we have referred. We quote at some length:

"At the present time the relations between the various factors which govern the flow of heat from a gaseous fluid into a metal surface with which it is in contact remain extremely obscure.

"The formulas in general use, which express in a concrete manner the views of engineers upon the subject, are of a purely empirical character, and without theoretical foundation. While differing to some extent in form, they agree in attributing wholly to greater or smaller differences of temperature between fluid and metal the higher or lower rates of heat transference which are met with in practice, and they entirely ignore any effect which may be produced upon that rate by a variation of the speed of flow.

"We accordingly find that our most scientific engineers devote their attention to the improvement of the processes of combustion, with a view to securing higher furnace temperatures, while no one appears to have made any attempt in the direction of causing the gases to part with more of their heat by accelerating the velocity of their movement relatively to the heating surface.

"Effect of High Speed Upon Conduction

"In tubes and flues of ordinary engineering size the fluids, whether gas or water, which travel along them hardly ever move in concentric sheets all across the bore.

"On the contrary, the motion of the gas

in boiler flues is always turbulent in the middle of the tube, so that the above-described process of conduction through relatively quiescent films of gas is liable to be interfered with by the intrusion of whirling masses of gas among the films from without. It thus no doubt happens, even when the speed along the flue is lowest, that a gust or eddy of hot gas occasionally breaks through the sluggish laminæ adhering to the plate surface, and gets contact almost with the bare plate itself. This is why projections on the flue surfaces, such as corrugations or retarders, or the placing of water tubes or other heating surfaces directly across the gas currents, greatly improves the ordinary excessively slow rate of heat transference in boilers.

"The improvement thus realized is as nothing, however, compared with that which can be secured by increasing the speed of flow of the gas to 10, 20, or 50 times that which now obtains in the flues and smoke tubes of steam boilers.

"The effect of such an increase seems to be that the adhering cooled films of gas on the surface of the plate are torn off in strips, so to speak, are rolled about, and enveloped in the body of the hot gas in the middle of the tube; and, instead of having to force the heat through a more or less quiescent film by the slow processes of gas conduction, described by Meyer, successive gas films are rapidly brought up to the bare plate, are cooled, and then whirled back into the main body of the gas, where they expose their enormously extended and attenuated surfaces for the reception of heat from the surrounding hot molecules. In short, we substitute the process of convection for that of conduction.

Actual Example of Effect of Increased Speed

"Returning now to our diagram, Fig. 1, of temperatures plotted across the plate, we see that the quantity of heat transmitted per unit area of plate per minute is proportional to the gradient of temperature through the plate itself.

"As a matter of fact, this 'drop,' or temperature difference between gas and plate will, unless the velocity of the water is also correspondingly increased, be still farther diminished, because the increased amount of heat transmitted implies a greater drop of temperature on the water side as well, in order to get the increased quantity through the same thickness of quiescent water film of given conductivity.

"This result is shown by the thick-line temperature curve marked 1500 degrees, 488 degrees, 440 degrees, 350 degrees, on the diagram, Fig. 1; and we see that the temperature of the warm side of the plate has been raised from 379 degrees to 488 degrees, and the temperature difference diminished from 1121 degrees to 1012 degrees by the above stipulated six-fold increase of gas speed, the heat transmission being at the same time increased from

6,600 B.t.u. per hour to 39,600 B.t.u. per hour } per square foot of heating surface.

"The rate of evaporation of steam corresponding to the latter rate of heat transmission is 41 pounds from and at 212 degrees Fahrenheit; and it is to be noted that it is effected through a plate with no unusually high gas temperature on the one side, or improperly low water or steam temperature on the other, but just under the conditions of the flue of an ordinary Lancashire boiler between the fire-bridge and the down-take.

"It need hardly be said that an evaporation of 41 pounds per square foot per hour from the indirect heating surface of a boiler is far beyond what most engineers would be willing to guarantee; but that it is no merely academic ideal impossible of

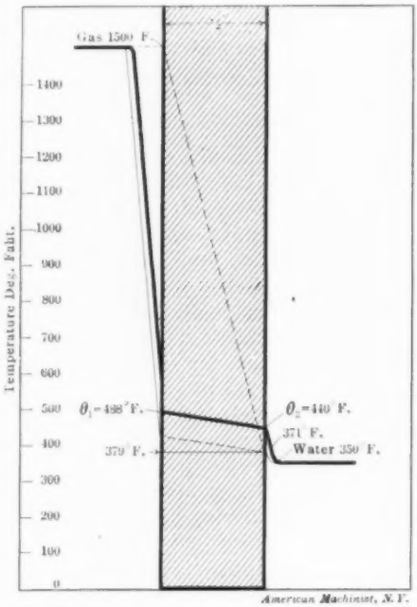


DIAGRAM OF HEAT TRANSFERENCE THROUGH A PLATE

achievement, the author can give his assurance. Evaporation at this rate has been reached and surpassed by him through the flue plate of a Cornish boiler, by the simple expedient just described of increasing the speed of flow of the gas in the flue to a degree which, although far beyond anything yet tried in steam boilers, is well below the extreme of what seems possible.

"The heating surface in question was not exposed to the direct radiation of the fire. The result was attained behind the fire-bridge in such a position that it is unlikely that there was any actual flame present at all."

The author then proceeds to describe in detail an experiment made with a Cornish boiler, in which a gas velocity of 330 feet per second was obtained—this is 8 or 10 times as great as the highest speeds of current practice—and a heat transmission of 34,450 B.t.u. per square foot per hour. In discussing the question of efficiency it is pointed out that a considerable amount of power must be used in driving fans to produce a high gas velocity.

The Import upon Boiler Practice of the Results Obtained

In the closing section Dr. Nicolson points out in what way his experimental facts may be expected to influence the practice of steam generation. We quote:

"In the first place, since the amount of heat that can be transmitted for a given temperature-difference is almost directly proportional to the speed of the gases, a reduction of area of the heating surface in steam boilers—to one-half, one-quarter, or even one-tenth of what is now usual—can be made without the chimney temperatures being raised or the efficiency lowered to any material extent. Or, otherwise, if the surface be kept the same, but the cross-sectional area through the flues be reduced, in order to obtain the necessary high gas speed, a very much lower chimney temperature and correspondingly higher efficiency can be secured than is now available.

"Accordingly, drafts of 10 in. of water gage, induced by fans, should always be employed for really economical working.

"In the case of boilers of usual construction, in which the gases pass through flues or tubes, and leave the boiler at a point where the temperature on the other side of the heating surface is that corresponding to the steam pressure, a limit will soon be reached as to the amount of draft suction which can be employed, and this from one or other of two causes:

(*a*) While the fire need not be forced, even when these high drafts are used, to a greater extent than that now usual, the high speed of entry of the glowing gas at the furnace end of the tubes will cause leakage, and some other construction for such purposes than that now generally employed must be sought for.

(*b*) The fall in temperature of the chimney gases due to the small flue section and accompanying high speed will, as intimated above, certainly provide an additional amount of evaporation which can be drawn upon to cover the extra power required for the fans; but the margin between present chimney temperatures and the lowest which are possible in ordinary designs of boiler under the above conditions is not very great, when the steam temperatures are from 350 degrees to 400 degrees Fahrenheit. A limit will, therefore, soon be reached beyond which it will not pay to pass. The author, after a careful investigation of costs and running expenses, has good reason to believe that this limit of draft pressure is, even for the ordinary type of boiler, much higher than that now in common use.

"In the second place, since the author's experiments have shown that, with a

counter-current flow of gas and water, i is possible to lower the gas temperature (at such high speeds as he used) to within 20 degrees Fahrenheit of that of the entering feed, we have here the evidence that chimney temperatures of 100 degrees to 150 degrees Fahrenheit can be reached and maintained, provided only high gas and water speeds are resorted to, and the boiler is designed on the economizer principle, with strict attention to counter-current methods of flow.

"Now such a low chimney temperature as this corresponds to a boiler efficiency of over 95 per cent.! The margin of additional evaporation available for the supply of the fan power is accordingly so much greater than is required, that not only can higher economies be obtained on this system than have hitherto been thought possible, but they can be effected with boilers having smaller areas of heating surface, smaller total volumes, smaller floor areas, lighter weights, and lower first costs than those we ordinarily employ.

"Finally, since the enhanced evaporative efficiency of the heating surface due to high speed, and its correspondingly reduced area, renders it possible economically to line that part of the surface nearest to the furnace with refractory material, and so to secure a non-water-cooled or reverberatory chamber in which the combustion processes may be perfectly completed, any special need for skilful firing is dispensed with; and, by providing plenty of air and an ample mixing space behind the bridge, excellent results, and an entire absence of smoke, may be obtained without special care.

"Such brick-lined combustion chambers cannot now be afforded next the furnace in ordinary boilers; for the heating surface at this point is almost all that the boiler has of even moderately good evaporative power, and it cannot be sacrificed, as convective heating surface, to be lined with a protective coating for the purposes of a combustion chamber.

"Nor is this all. Any lack of high furnace temperature accompanying such air excess can so easily be made up for by the additional gas speed that nearly the whole heat value of the coal can still be passed into the water, even when the flue gases are relatively cool, without any undue extension of the heating surface being found necessary. We see also that the extra quantities of air just mentioned may be admitted to the furnace without encountering the evil results which usually follow such a course. For, as practically all the heat is extracted from the gaseous products before they reach the chimney when this high-speed counter-current method of working is adopted, it matters but little to what extent they are diluted.

"Thus the proposed new method of working, using both high-speed and counter-current gas and water flow, appears to be capable of introducing several features of radical improvement into the present practice of steam-boiler construction and working.

"The author ventures to believe that some such features must shortly be incorporated in boiler design if the steam engine is to retain the pre-eminence it has so long enjoyed in the economical production of power."

The West Side Automobile School of New York City

It has been stated that the West Side Y. M. C. A., of New York City, was the first institution to recognize the value of a training school on the automobile. Whether or not they are justly entitled to this position of priority, their automobile school is today one of the largest and one of the most successful educational centers exclusively devoted to the training of prospective owners and chauffeurs in the art of automobile adjustments, maintenance and operation. The continued progressiveness of the educational directorate of this association is shown by the fact that a series of lectures on aëronautics is now being given with the purpose of establishing an aëronautical school this coming autumn.

The automobile school was established in 1904, with an advisory committee of active members of the Automobile Club of America; in fact, several of these gentlemen furnished financial assistance during the early years of the school, or until it had passed through the experimental stages. To date it has trained something over 3000 men, of whom fully one-half were automobile owners or prospective owners.

FIG. 2. GARAGE OF WEST SIDE AUTOMOBILE SCHOOL

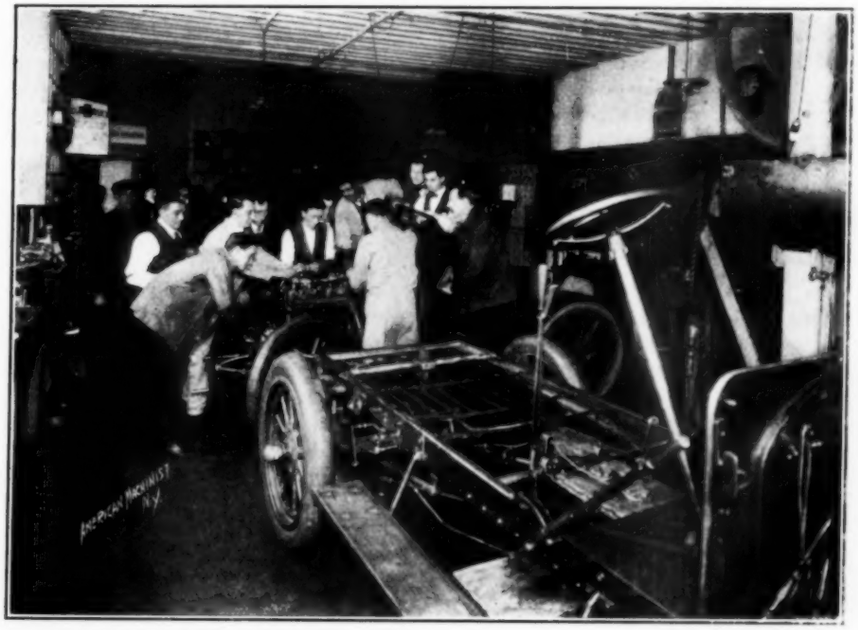


FIG. 1. CLASS ROOM OF WEST SIDE AUTOMOBILE SCHOOL

The remainder were men who purposed to be professional chauffeurs, or were coachmen, or other employees sent to the school by their employers in order that they might learn the art of automobile handling. The students are not drawn from New York City alone, but come from various sections, as the West and South. The democratic character of the school is shown by this mixture of students, and is happily illustrated by an incident which occurred only a few days prior to this writing. A certain lawyer registered himself and his coachman as students in the school, and requested that they should be assigned to the same class, in order that they might receive identical instruction. Is there any other country in the world where such a situation could arise?

Taken by years, the student enrollment has been as follows: 1904-5, 300; 1905-6, 648; 1906-7, 817; 1907-8, 683; 1908-9 to date, 497. The monthly enrollment for the current year is such that the high record of the season 1906-7 will undoubtedly be equalled, if not bettered. The school year is from September 1 to August 1. Two courses are provided, one of eight weeks' duration, requiring two periods of shop work each week; the other of four weeks' duration requiring four periods of shop work per week. In addition each course has eight 1-hour lessons of road work.

The salaried teaching force is composed of 12 members: a principal, five class-room instructors and six road instructors. The tuition fee for the entire course is $55.25 for nonmembers of the association and $50 for members.

The Shop Work

The shop work is an excellent illustration of the modern tendency toward purposeful teaching. Of formalities there are none, but of results there are many.

Many, and in fact, most of those who come to the school have an extremely limited knowledge of machinery and none of automobiles, and the instruction must, of course, be adapted to them. It hence begins with elementary explanations of the construction and action of the various parts of the machine. As the work advances the various adjustments are taken up and the success of the most inexperienced, in a mechanical sense, is surprising. One of the exercises consists in sending the students out of the room while the instructor "queers" the car and then assigns two of the class to find the trouble while others look on, this process being repeated until all members of the class have had a chance and until the usual forms of trouble have been exhausted. In these exercises the valves may be disarranged, one or more buzzers may be thrown out of adjustment, the gasolene supply may be choked and many other things done. On a recent occasion but a single squad of two out of the entire class failed to find the cause of the trouble, and their failure was due to a change in instructors that evening, combined with the fact that the new instructor assumed a certain thing to have been explained that really had not been explained.

On another occasion when the work in progress was the adjusting of the commutator and connecting it to the spark plugs —a process that requires considerable acumen in order to make the proper connections—all of the squads succeeded in making the corrections properly, the final test being in all cases that the engine shall start and run properly after the work is finished.

The shop work consists of 16 lessons of three hours each. It is pervaded from start to finish with the spirit of which the above are illustrations, and that the results are good cannot be questioned.

The Road Work

All of the road instruction is individual. The pupil is under the tutelage of a trained instructor, who takes him first to unfrequented streets and teaches him the art of steering, changing speed, manipulation of the clutches and straight driving. Then follows a few hours of practice on the best of road surfaces, such as are found in the parks and along the boulevards; then some hill-climbing trials, the turning of curved corners, sharp right angles, and speeding where it can be done with safety. Lastly, the student is taken to congested streets and is there taught how to dodge vehicles, pedestrians, to pick his way successfully between trucks, cars and the hundred-and-one obstructions which are met with along our crowded thoroughfares. With this ordeal successfully over, the student is entitled to a graduating certificate, which is today looked upon by garage and car owners as standing for thoroughness and quality in automobile training.

The Illustrations

The accompanying illustrations, Figs. 1 and 2, show, respectively, the class room and the garage of this automobile school, located at the northeast corner of Broadway and West Sixty-third street. The view of the class room shows a class with its instructor gathered around an automobile, and receiving the instruction as has been outlined under the column heading "The Shop Work." Most of the equipment of this school has been donated by manufacturers who believed in the work and were interested in its success. The class room has four cars and one detached engine. These cars are: One 2-cylinder Darracq; 1 twin-cylinder Auto car; 1 four-cylinder, 24-horsepower Locomobile; 1 four-cylinder, 50-horsepower Haines. The detached engine is a 4-cylinder, 26-horsepower Dragon. From this illustration it will be seen that some of the cars are stripped of bodies, and all of them are stripped in such a manner that the engine —the part upon which the instruction is centered—is easily accessible from all positions. In addition to these cars the equipment includes various makes of magnetos, carbureters, radiators, etc.

The equipment for road work, shown by Fig. 2, consists of two 24-horsepower Locomobiles, one 30-horsepower Haines, one 20-horsepower Maxwell, and two 12-horsepower Fords.

The Metal Trades Associations

The New England branches of the National Metal Trades Association have been kept busy recently with their annual meetings to elect officers for the ensuing year. Boston and Worcester both held theirs on March 9, the former reëlecting E. E. Bartlett, president, E. P. Robinson, vice-president and D. D. Russell, treasurer, while the offices have been moved to 141 Milk street, Boston. D. F. S. Clark remains as secretary.

The Worcester branch elected John R. Back president, George I. Alden vice-president, Charles F. Marble treasurer and Donald Tullock secretary.

On March 10 the Providence branch held its annual meeting at which E. A. Beaman was elected president, Henry D. Sharpe vice-president and John Aldrich treasurer, Joseph A. Holland being secretary as before.

These branches are particularly active and have done much to further the good fellowship that should exist between the men in any line of work.

The more progressive city libraries of the country are paying increased attention to engineering and technical subjects in their work with the public. Among those which are especially active in this field is the Public Library of Washington, D. C., as shown by the annual report of 1907-08, recently issued. This institution has organized a special department, the useful arts department, to meet the demands of its readers for books on the engineering branches, trades and handicrafts, business and industries in general. Here on open shelves are placed about 6000 well selected volumes, purchased very largely within the last three years and many of them expensive. Over 160 periodicals are received, which include nearly all the important American publications and some foreign. All these periodicals, both current and back numbers, are freely accessible. All but current numbers are issued for home use. Various engineering indexes make their contents accessible. An important feature of the room is the collection of trade catalogs issued by manufacturers. These catalogs are classified and arranged by subjects on open shelves and are indexed by firms. This feature, according to the report, is much appreciated by patrons of the room. Manufacturers and others in distributing advertising literature would do well to keep this library in mind.

Universal Radial Drill Equipped for Jig Work

Arm Has an Outboard Support and Hydraulically Operated Table Is Provided for Adjusting Work Vertically to Different Positions Required.

BY A. J. BAKER*

The accompanying photograph and drawings show some attachments that have been applied to a Bickford universal radial drill recently installed in the shops of the Cincinnati Milling Machine Company.

The machine in question is mainly used for large jig work in connection with power required, and also wear out the jig bushing in much shorter time. To remedy this the machine was fitted with a 4-inch trunnion bolted to the end of the arm, and located centrally with its horizontal axis. This trunnion was carried in a holder, which in turn was fastened, as shown in Figs. 2 and 3, to a bracket bolted to a cast-iron base plate sunk level with the cement foundation. The machined face of the bracket has a T-slot cut therein and the holder having a tongue fitting in the neck of the slot can be slid up and down with the arm; the position of the arm being decided upon, two T-bolts fasten the holder to the bracket. By doing this two things are accomplished: First, the head and arm are braced firmly against the thrust from the drill. Second, the varying deflection of the arm due to the position of the head with respect to the column, is eliminated, so enabling the head to move along the arm with the tool at a constant hight from the table.

So much for the first of the desired

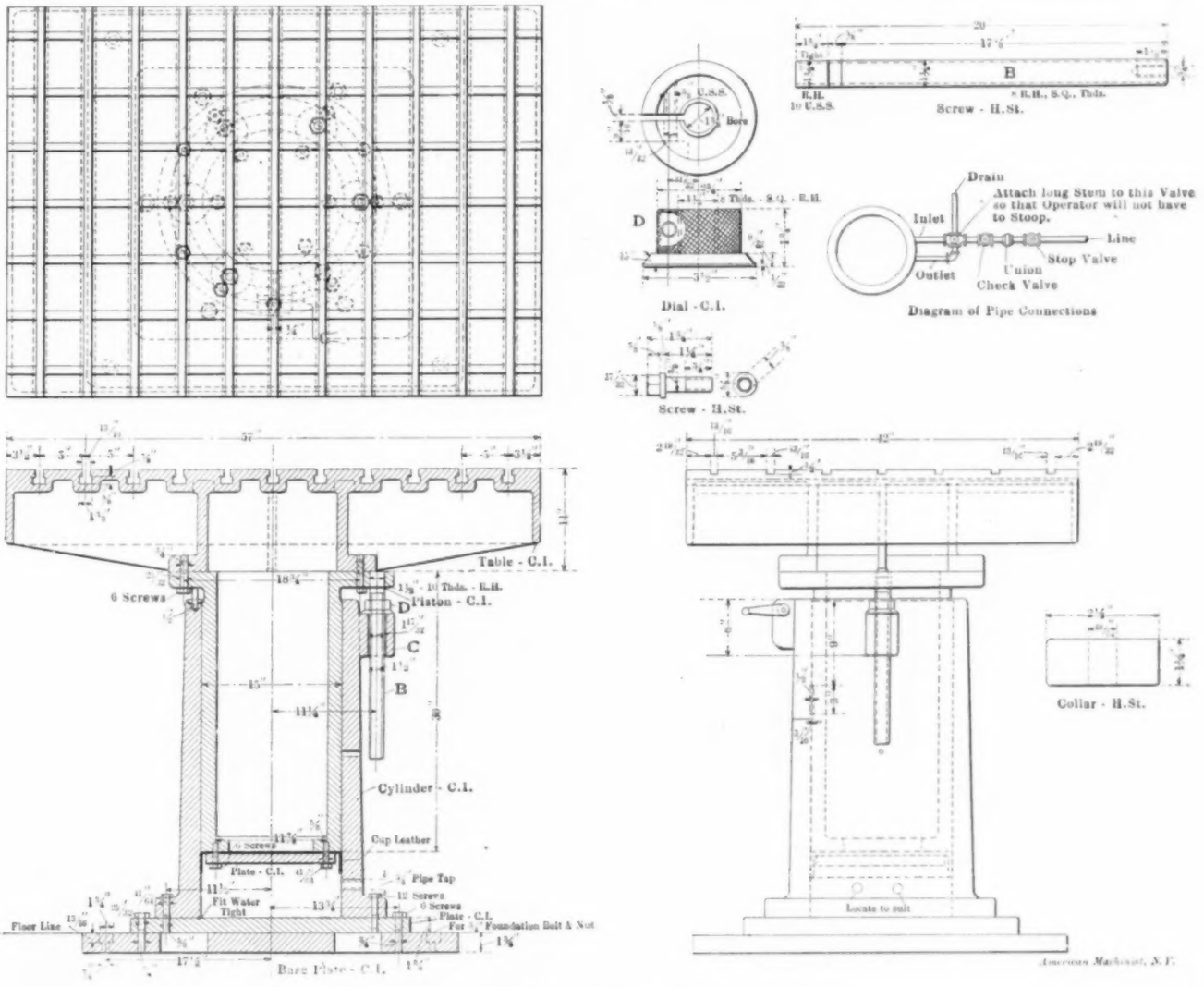


FIG. 1. HYDRAULICALLY OPERATED TABLE FOR RADIAL DRILL

which coarse feeds and comparatively fine spindle adjustments are needed. With respect to the former, it is hardly necessary to say that a 2-inch high-speed twist drill, fed to the limit in cast iron will, if applied from the end of the radial arm, cause considerable spring in that member and thereby increase the amount of

*In charge, tool designing department, Cincinnati Milling Machine Company.

conditions; as to the second: The movement of the head along the arm is hand actuated and is sufficiently sensitive to enable the operator to bring his spindle opposite any particular spot in a horizontal plane with all necessary accuracy.

The vertical movement of the arm up and down the column, however, is obviously by power feed and presents a difficulty when it is desired to obtain an ac-

curate location, especially when it is required to use the head at the outer end of the arm, because of the clutch lever being situated close to the column. It was consequently decided to leave the arm in a fixed position and obtain the vertical adjustment by means of the special work table, seen in Figs. 1 and 2.

Consideration of the different methods of actuating the table resulted in the selection of the city water supply and with that motive power the table is now working. The advantages of the hydraulic system are: First, delicate adjustment; second, simultaneous horizontal and vertical movements; third, simplicity of operation; fourth, durability; fifth, cheapness.

The details of construction are shown in the drawing, Fig. 1, and the main dimensions are as follows: Surface of table, 42x37 inches, containing eleven 13/16-inch T-slots, and seven 13/16-inch tongue slots, so arranged that jigs from a Lucas boring machine can be used. Diameter of piston, 15 inches; length of stroke, 14 inches; minimum distance from center of spindle to top of table, 3 inches.

The water pressure is 60 pounds per square inch. The water is fed from the main, through a three-way valve, and returned from the cylinder to the drain. Inlet and outlet are governed by the handle *A*.

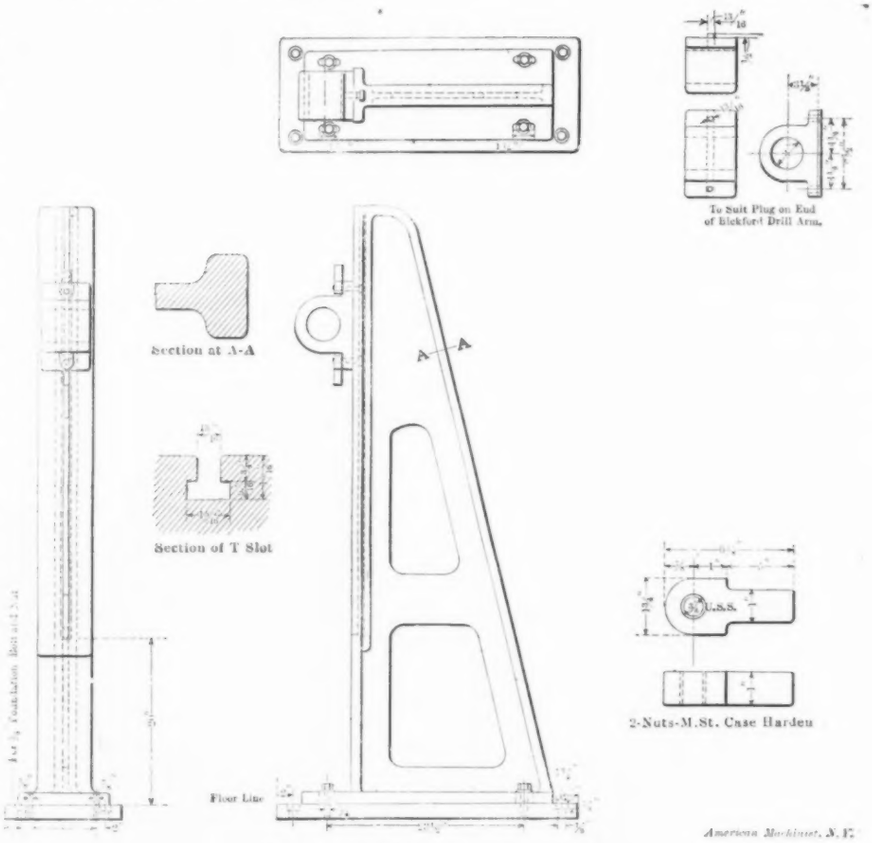


FIG. 3. RADIAL DRILL ARM SUPPORT

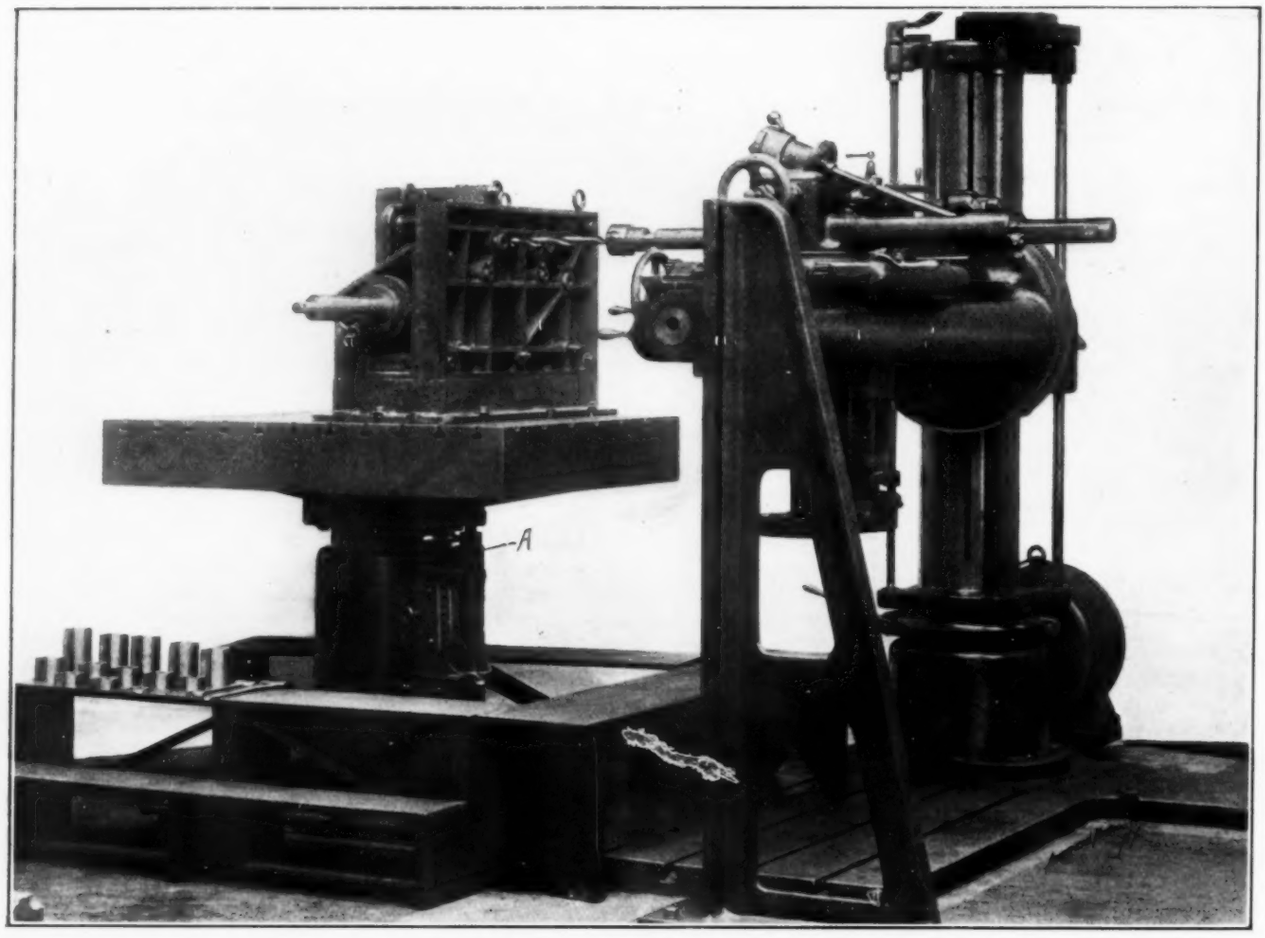


FIG. 2. RADIAL DRILL EQUIPPED WITH ARM SUPPORT AND HYDRAULIC WORK TABLE

Fig. 2, which is brought up to within easy reach of the operator. Below this handle are situated the starting switch for the driving motor, and the speed variator, thus affording a concentration of controlling members highly desirable and convenient. It will be noticed that a number of split or "U" collars of various hight are shown on the bench in front of the table. These act as dead stops and enable the exact vertical position to be easily and accurately obtained in the following manner: Fastened to the under side of the flange on the piston is a stout screw *B*, Fig. 1; this screw passes through a clearance hole in a lug *C* cast on the side of the cylinder. The upper face of the lug is machined. A split-adjusting dial *D* can be moved on the screw and locked in any position desired. The operator, when setting up to drill work in a jig similar to that shown in Fig. 2, just sets the drilling-machine spindle opposite the upper hole in the jig. He then moves the dial down the screw until it rests upon the lug, and in that position, clamps it.

Having finished the first hole he opens the valve and the table rises until a split collar, the length of which equals the vertical center distance between the two holes, can be inserted between the dial and the lug. Then by letting the table down until the dial rests upon the collar, the necessary space has been traversed. By providing a number of collars or washers whose length equals the distances from the starting hole to the others, the operator is not called upon to exercise any particular care in getting the right hight and can devote his attention to making the longitudinal adjustments.

Such accurate adjustment is not, of course, so necessary in jigs wherein a boring bar is used that is guided in bushings on both sides of the work, so permitting the use of a universal coupling between the spindle and bar, but in the case of holes, especially long ones, formed with drills and reamers only, it is imperative to have a good adjustment.

When it is desired to use the machine for work other than that which the table will accommodate, it is a matter of a few moments only to remove the supporting bracket from its base plate. The hydraulic table can also, if necessary, be taken away, as that too rests on a cast-iron bed plate.

A preliminary report recently published by the Bureau of Census shows that the number of telephone lines and systems in use in the United States, exclusive of Alaska, is 22,971, with a total single-wire mileage of 12,999,369. Over these wires it is estimated that during the year 1907 as many as 11,372,605,063 messages were delivered. The telephone industry gave employment to 143,721 men and women, and the salaries and wages totaled $68,279,127.

The Caskey Hydro-Pneumatic Bending Machine

By C. M. Hamersly*

A multiple-pressure machine that is noteworthy for embodying a new system of operation has been introduced by S. S. Caskey, of Philadelphia, Penn. The first of these machines has now been in operation at the Link Belt Company's Philadelphia plant for nearly a year.

In designing the machine advantage was taken of both hydraulic and pneumatic principles; a maximum pressure of 360 tons is concentrated on the bending dies. The machine will bend cold ⅜-inch steel plates 8 feet long. As will be seen by referring to the illustration, Fig. 1, the machine is of massive construction. The upper and lower beams are connected by four vertical tension members each 5 inches in diameter and spaced 8 feet 10 inches, longitudinally, from center to center. They act as guides for a sliding beam to which is attached the upper bending die; the lower die rests on the top of the lower beam or base. Downward motion is given to the sliding beam by means of four rams, each 4¾ inches in diameter and 26½ inches on centers longitudinally; these protrude from cylinders contained in the upper beam and the upper or pull-back motion is produced by means of two pull-back cylinders *A*, Fig. 1, which are fastened to each end of the upper beam; the pistons of which are connected to the sliding beam.

Upon the top of the upper beam is the power-producing element. The construction of this mechanism will be seen, by referring to Figs. 1 and 2, to consist principally of a high- and low-pressure air cylinder, whose pistons are cast together, an oil reservoir, an intensifying chamber and four hydraulic rams. The intensifying tube which is contained in the oil reservoir is connected to the cylinders of each ram by an arrangement of piping. Valves have been provided for each cylinder so that the connection may be cut off if desired.

When the rams are at the bottom of their stroke, oil is applied through the reservoir until the chambers in the four

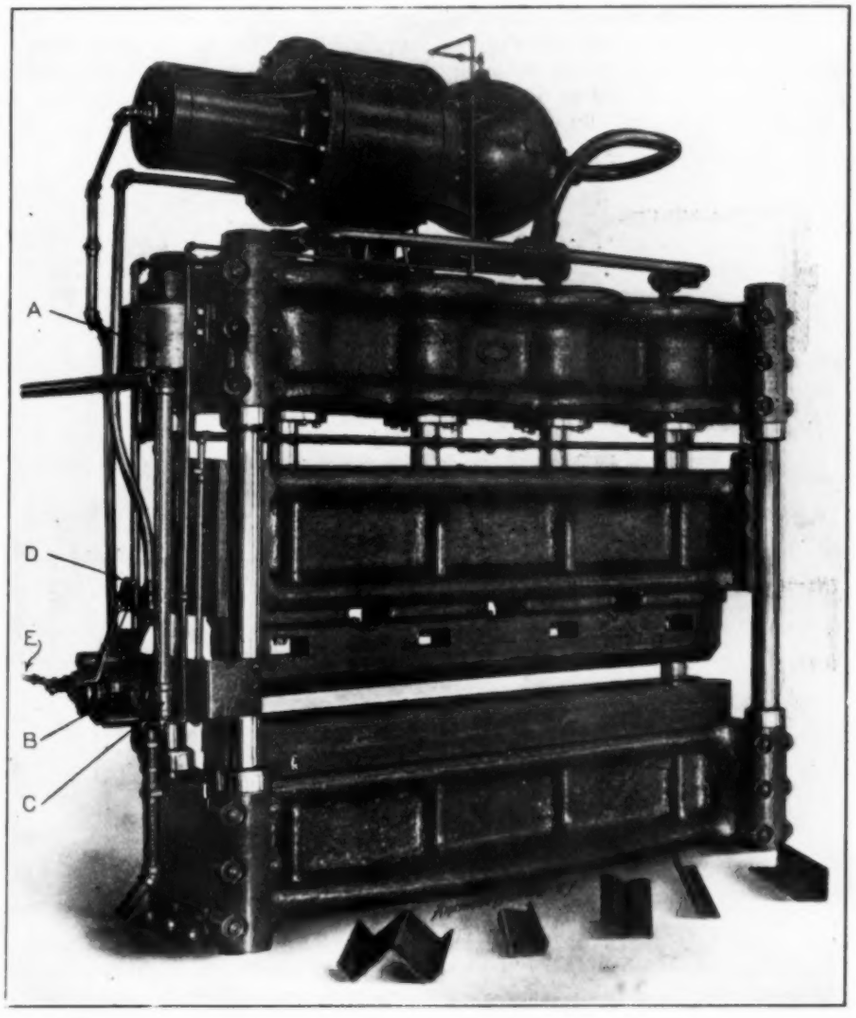


FIG. 1. "CASKEY" HYDRO-PNEUMATIC BENDING MACHINE

*Engineer, Link Belt Company.

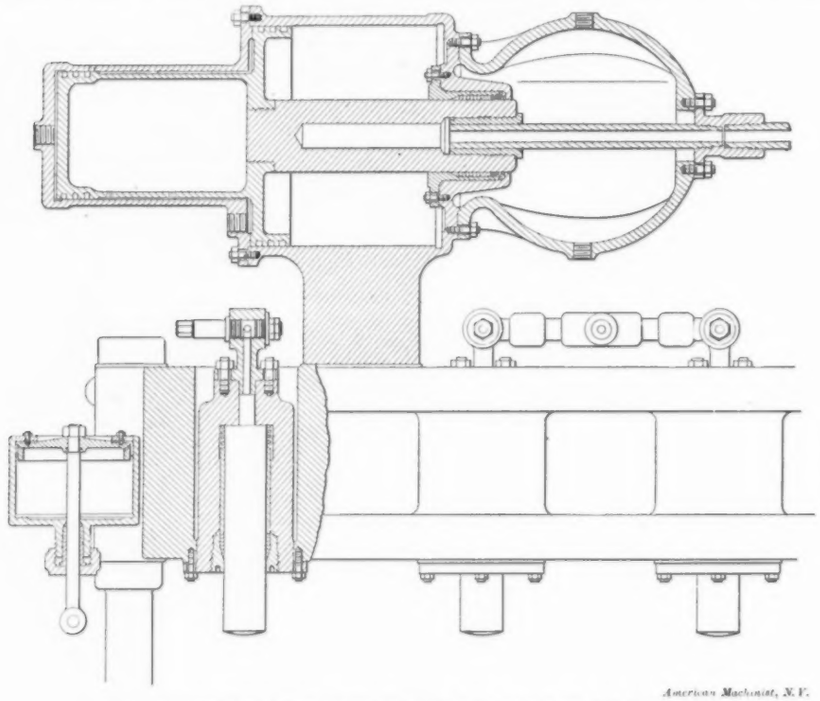
cylinders and piping are filled and the oil has reached the level in the reservoir, shown by the dotted line, Fig. 2. The oil is prevented from getting into the adjacent air cylinder by means of a gland, which also acts as a guide for a shell-like plunger which is attached to the air piston.

Action for this mechanism is controlled entirely by the valves, which are conveniently located at the left side of the machine near the base, Fig. 1, *B*. An air pressure of 100 pounds per square inch enters the three-way throttle or operating valve. By means of the operating lever, Fig. 1, *D*, this pressure may be made to act on the pistons of the pull-back cylinders, causing the sliding beam to rise to its maximum upper position, at the same time allowing any pressure that may be in the other chambers of the valves or air cylinders to escape through the exhaust, or pressure may be admitted into the adjacent distributing valve chamber, at the same time connecting the pull-back supply with the exhaust. By setting the distributing lever, Fig. 1, *E*, in one of its three positions pressure may now be distributed to either the high- or low-pressure cylinders or to both collectively. The valve is so arranged that the pressure from the air cylinders not in use is allowed to work without pressure through the exhaust.

From the previous description it is evident that a pressure of 100 pounds per square inch may be applied to any one of three areas that will cause the air pistons to move forward in their cylinders. As the shell-like ram is attached to these pistons this movement will cause it to slide upon the intensifying tube, and transmit its total pressure on a column of oil in the intensifying tube which in turn transmits the power to operate the various rams in a downward direction.

The air cylinders are designed to give a pressure of 30, 60 or 90 tons on each ram. As each ram may be cut off independently, any one of four pressures may be obtained on the sliding beam for each one of the three pressures on the air pistons, making twelve pressures in all that may be obtained on the dies. The sliding beam has 8-inch stroke. When a full pressure is on the air pistons a pressure of 10,000 pounds per square inch is on the rams.

Owing to the number of tight joints required that have to withstand this pressure, the matter of an efficient packing is of the greatest importance. Mr. Caskey has employed his usual method used in connection with his valves, of providing packing rings which obtain pressure through a number of portholes that communicate with the recess in which the packing is inserted, thus exerting a pressure on the packing from the back and insuring a tight joint that becomes more effective as the pressure under which it is used increases. As will be seen from Fig. 2 this method has been employed in the glands, pipe fittings and valves whenever the high pressure is to be held in check. A notable feature of the valves is the absence of the usual taper plug, stuffing boxes and all pockets where scale or grit might lodge. The valve does not contain any exposed valve seat and the plug being straight makes it evenly balanced throughout. The machine takes up a space of about 3x10x12 feet and weighs about 36,500 pounds.



American Machinist, N.Y.

FIG. 2. ARRANGEMENT OF CYLINDERS AND RAMS OF 350-TON HYDRO-PNEUMATIC BENDING MACHINE

Revocation of Patents in England

By Dr. Alfred Mueller

The comptroller-general of the British Patent Office has rendered his first decision in the matter of an application for the revocation of two British patents. The patents are No. 6455 of 1900, and 22,139 of 1900, and were both issued for a "Process of Manufacturing Imitation Stone Slabs or Tiles." The patentee had given an exclusive license to a Belgian company, which had put the invention in commercial operation in Germany, France, and Belgium, and the article was manufactured entirely outside of England and imported into said country.

According to the new British patents act, the patentee should have taken steps before August 28, 1908, to have his invention also carried out in England. At the eleventh hour an English patent agent firm was instructed to insert advertisements in various British journals to the effect that the patents were for sale, or that the owner was ready to enter into a working arrangement with firms in England, interested in the process covered by the patents. The patent agents had also been instructed to address direct offers to British firms. In the hearing before the comptroller, however, the fact was brought out that the firms which had been written to, except one, were not tile-makers and makers of terra cotta and imitation stone, but brickmakers. The further fact was brought out that the patentee was not in the position to grant a license for the reason that he had given an *exclusive* license under his patents to the said Belgian company. It was urged, therefore, by the applicant for the revocation of the patents that no steps were taken by the patentee until the very last moment, when the term for beginning working in England had nearly expired and consequently no British manufacturers would feel inclined to enter into any arrangement with the patentee, and further, that the steps taken by the patentee were not calculated to effect the purpose required by the act, besides having not been *bona fide*, and that the patentee had not done anything to adequately supply the trade in England, and also, that by alleging infringements and threatening harassing litigation he had endeavored to keep up artificial prices for the goods manufactured by him. The allegation by the patentee that the article could be manufactured more cheaply outside of England could not be supported by facts.

By the decision of the comptroller, both patents were *revoked*, the revocation to take immediate effect, and the patentee was ordered to pay to the applicant for the revocation of the patents the cost of the proceedings £47 7s. ($235). The comptroller's decision may be appealed.

The Patternmaker and the Foundry—I

Different Methods of Molding a Ring Separator. Why the Patternmaker Should Have a Knowledge of Foundry and Shop Methods

BY PATTEN MOLDE

In addition to the knowledge of mechanical drawing, and the ability to use the tools necessary to build a pattern with, there are many things that are essential to the making of an efficient and practical patternmaker: Things which will enable him to readily adopt the ideas of the designer; to mentally conceive the form and proportions of an object not yet existant; and to make allowance for the operations of the different mechanics which follow him in the work.

For instance, it is essential that he should have a general knowledge of machine-shop practice, otherwise he may add considerably to the cost of machining some castings, by neglecting to provide the necessary tool clearance, or by a too small or too great finish allowance, etc. It is not expected of him that he be able to do the work in the machine shop, but a knowledge of what can be done with modern machine tools will be of much benefit both to him and to his employers. Observation will provide this essential within the range of his own experience, and the trade papers will tell him what others are doing.

Then again he must have something more than a speaking acquaintance with practical geometry, if he would save both time and material in working out some jobs that come to him, besides making it easier for himself.

Knowledge of Foundry Methods a Necessity

But above all other things that are essential to the competent patternmaker, with the exception of his ability to read the drawing, is a knowledge of foundry practice. A knowledge of the first principles of molding is necessary to the ordinary patternmaker, for without this knowledge he is working in the dark, and this is unsatisfactory to say the least. The wider, deeper, and more full the patternmaker's knowledge is, of foundry practice, the better will be his rating as an efficient mechanic.

Any competent woodworker might make a satisfactory model of an object, but this would not make of him a patternmaker for a pattern is not necessarily a wood model of the object required, but something that is a means whereby the molder is enabled to produce that object in metal. It may differ so far, in appearance, from the object itself as to be a puzzle even to the designer, and yet be the best means of attaining the desired end.

A few sawed strips of wood, a square, a spirit level, a sand pile and a good molder may produce a large plate casting at a less cost than the cost of a full pattern, while at another time the number of castings required would make the building of a pattern necessary and the best means.

Difference in Methods

Sometimes a few minutes spent modeling in sand will save hours of work in the pattern shop and be just as good and sometimes even better for the molder, while at some other point in the mold it would be unadvisable or perhaps impossible.

Very often there are a number of different ways for making the same piece, and the most expensive pattern is not always the best for the molder. A full pattern of some object may cause him more work than some less expensive method would.

These are a few hints that show the necessity for the patternmaker to know how, when, why and where to apply these different methods if the best and most economical means are to be adopted in the production of any given casting. Foundry methods differ in many respects in different shops when making similar objects and the patternmaker should know why.

Foundry methods, too, are ever chang-

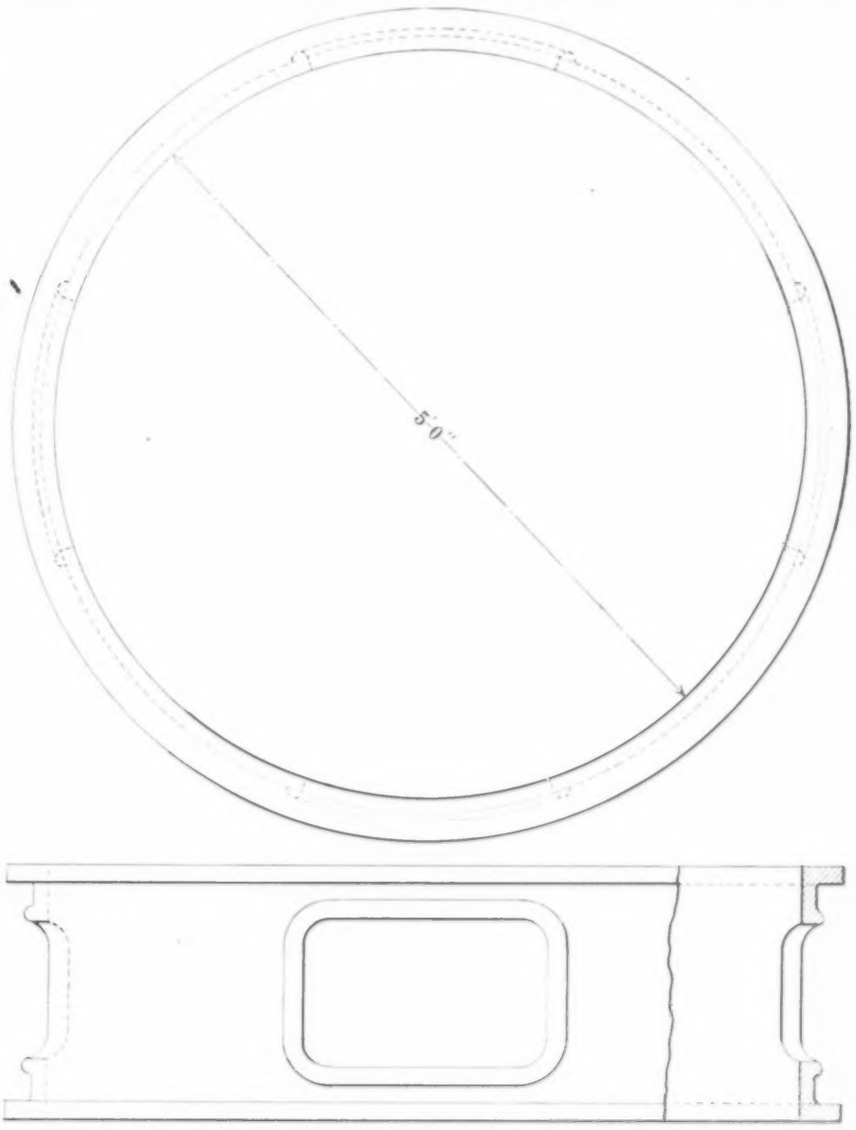


FIG. 1 A SEPARATOR FOR WHICH A PATTERN IS TO BE MADE

ing, especially since the introduction, improvement and development of the molding machine; thus presenting many different problems in the making or mounting of patterns. The patternmaker must keep ahead of the procession by con-

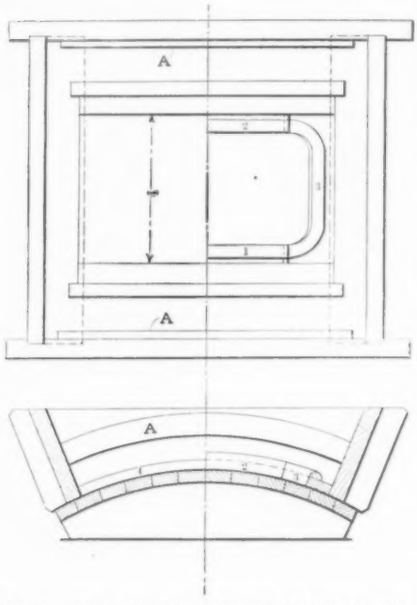


FIG. 2. CORE BOX FOR OUTSIDE OF SEPARATOR

tinually gathering new ideas by observation, study and experience.

Interesting the Apprentice

It is a difficult matter to get the average patternmaker's apprentice interested in the foundry end of the trade, probably because the color of the sand does not appeal to his artistic temperament, or his first conception of the trade did not embrace any idea of working in sand and dirt. It was the woodworking end of it that appealed to him and it takes a lot of preaching to get him to understand that what he considered the whole of patternmaking was only a part, and that not the most important part of the trade. Of course there are exceptions, and I have in mind two apprentices who embodied the two extremes of this idea.

With the first one it took four years of drilling to make him a reliable, neat and accurate woodworker, but in two years he knew more of actual patternmaking from the needs of the molder, than many journeymen with five times his experience. Why? Because he was always interested in the foundry, and his spare time mornings and noons was spent there. If you missed him through the day, you would most likely find he had been sent to the foundry on an errand and had forgotten to hurry back. It is needless to say that his foreman encouraged this interest, and if anything special was on hand in the foundry gave him the opportunity to see it. Having in the meantime acquired skill and accuracy in the use of his tools he made good right off from the expiration of his apprenticeship.

The Clean Apprentice

The second one was always neat and clean, both in his person and in his work, and almost from the start was a skilled woodworker. It was not long until you could always rely on his work for accuracy in measurement, and the job was usually a work of art, time not being considered. But if he ever thoroughly mastered the principles of molding and particularly cored work, it was after he passed beyond my control.

Both of these apprentices had equal opportunities, but the first one took up much less of the foreman's time than the second and proved to be the most competent mechanic. The first learned by observation; the second learned some things because they were told to him.

Many pattern-shop apprentices do not have free access to the foundry, and it is only at intervals that they get a chance to see one; these, of course, must rely largely on what is told them, and, therefore, I will present a few examples of molding, out of the ordinary practice, whereby a better or more economical result was attained in the production of the castings.

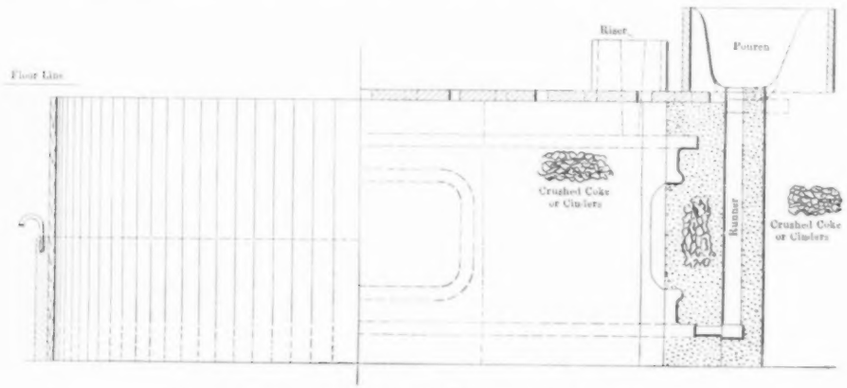


FIG. 3. SHOWING THE CONSTRUCTION OF THE MOLD

Shell Pattern

The first example is the molding of a circular distance piece, or separator casting, as shown in Fig. 1. In the making of any pattern the first consideration should be to find the best and most economical method of molding, and second, the cost of construction of the pattern. These two ideas should be well balanced before commencing operations.

If economy in molding means extra cost in pattern work, and not sufficient castings are required to counterbalance this, it would not be wise to adopt this method, even if the foundryman should kick, for it is the total cost of production that counts. The foundryman should always be given the benefit of the doubt, and favored if possible, because the casting may have to be duplicated at some future time, though not expected, and whatever was gained in the first case would be lost on the second.

There are several ways in which the pattern for the casting shown in Fig. 1 could be made and molded. For instance we could make the pattern follow the

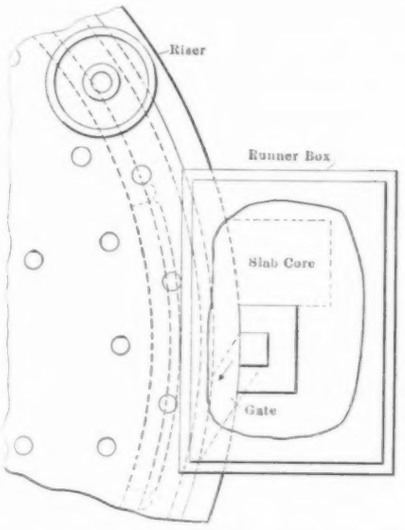


FIG. 4. PLAN VIEW OF THE POUREN RUNNER AND RISER

lines of the casting as closely as possible, by turning it, both inside and out, to the required size and metal thickness. The lower flange would then be put on loose, and loose coreprints would be put on the outside, for forming the openings through the side of the casting. These would be large enough to take in the bead around the edges.

If made this way we have a pattern that is the cheapest in construction for a full pattern, but one whose life would not be long, owing to the effect of dampness on the wood and glue, and the heavy strain in drawing so deep a pattern. Besides this we make it necessary for the molder to either cheek off the outside of the pattern, or to lift out the center core, in order to finish the mold and to place the four cores for the openings. These cores must also be kept thin so that the center core may pass them, without rubbing when closing the mold. It

also causes a heavy fin that must be chipped away later.

If the molder lifts out the center core, he must provide a lifting plate that is suitable for the job. One having three lifting eyes on the top side and three pins to fit sockets on the under side, for locating the core in its proper position is the best to use. If he cheeks off the outside he must have a specially arranged flask, with suitable iron chucks or bars.

There is no doubt that a casting could be successfully made by these means, but to my mind it is the least desirable method when both economy and the results are considered.

Solid Pattern

Then again we could make what is usually termed a solid pattern, which would have the outline of the outside of the casting by making one flange loose. The beading around the openings would also have to be loose, in which case it could be made of pattern metal.

The pattern would be closed on the top and bottom, and prints formed on it to center the central core or cores. The pattern would then need a core box for the center core.

In this case I would make a box ⅛ of the circle, that extended back from the outside about 15 inches. This would leave a space, 30 inches in diameter, to be filled in with green sand after the cores were set, and would give the molder a good opportunity to carry his vents from these cores when filling the space.

This method enables the patternmaker to build a stronger pattern, and it requires no special rigging in the foundry that would not usually be at hand in any well equipped shop, but it is the most costly, in time and material, in the pattern shop. In this particular case there was not sufficient castings required to warrant the expense in the pattern shop, so it was necessary to seek some other way.

Core Molding

The method known as core molding was adopted and proved more economical in both the pattern shop and foundry, than either of the two methods aforementioned.

A core box was made, as shown in plan and section in Fig. 2, of ⅛ the circumference. To the left it is shown, as arranged for the four plain cores, and to the right as arranged for the four cores that form the openings in the side of the casting. Pieces 1, 2 and 3 form this opening and when these are removed, piece 4 takes their place and closes up the space, leaving the metal full. Two pieces *A* are put in the side of the box as a track for a sweep, which strikes the core off to this line. The box is then filled to the top with molding sand, to bed the core on the plate while drying.

A pulley ring was found in stock,

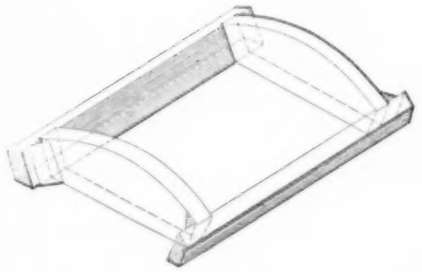


FIG. 5. CORE BOX FOR CENTRAL CORE

whose inside diameter was 1 inch too large, so enough strips to encircle it were gotten out, that were the full length of the depth of the outside cores, made in the box shown in Fig. 2. The inside core was molded in green sand with this, as shown in the left of Fig. 3, by drawing up the pulley ring, as the ramming proceeded, by the hook shown.

The cores that were made in the box in Fig. 2 were then set around this central core, alternating one plain core with one with the opening in. The runner was made in one of these cores, as shown in the right of Fig. 3, and in plan view in Fig. 4, and the riser was located in the next core.

The whole was then secured by ramming sand around the outside and it was ready to pour when the pouren and riser had been made.

Box for Central Cores

If there had not been a suitable pulley ring in stock, a core box, as shown in Fig. 5, would have been provided. This calls for eight cores to the circle. The cores would then have been stacked up with the joints overlapping those of the outside cores. In ramming these up the ramming should be carried up about even on both the outside and inside. The method adopted in making this casting is applicable to many others, being modified, of course, to suit the form of casting required and would prove that economy and practicability may go hand in hand at least some of the time.

Ability by Comparative Values

By Ralph W. Davis

The question of salary is probably the most troublesome one that an executive has to handle; to keep down the pay roll and also keep a contented force of men requires considerable tact. In order to maintain an equitable arrangement of salaries and at the same time have information by which increases might be governed, the form here shown, Fig. 1, was put into operation and has worked successfully for several years.

Reports are made out on the form each quarter by the squad leader, or section foreman, and handed to the chief draftsman. The chief having also made out a report of the entire force compares his estimates with those made by the subordinates and is thus able to catch anything which looks like "favoritism" or "knocking," so that the official record is fair and just. Fig. 1 only shows the headings and an example in each class; a working form would be ruled up for as many names as required.

Designers are men capable of carrying a proposition through from start to finish. Secondary designers are men, who under direction of designers will lay out minor movements and design detail parts, and make detail drawings if required. Detailers and tracers make detail drawings and trace them.

The column headed "top rate" gives the highest salary that will be paid for a 100-per cent. man of that class. "Rate paid" gives weekly rate man is getting; "value" is derived from the percentage total and shows whether the man is underpaid or overpaid.

The actual figures in these three columns appear only in the confidential report as filed by the chief draftsman.

	Designing Ability.	Accuracy.	Neatness.	Availability for Advancement.	Familiarity with Apparatus.	Punctuality.	Speed.	General Conduct.	Total Per Cent.	Top Rate.	Rate Paid.	Value.
Designers	45	22½	5	5	5	5	10	2½	100	$35.00		
Blank, John	40	20	5	3	5	5	10	2½	90½		$27.00	$31.67
Secondary designers	40	22½	7½	5	7	5	10	3	100	20.00		
Doe, Robt	35	22½	7½	3	7	4	8	2	89		19.00	17.80
Detailers—Tracers	30	22½	15	10	5	5	7½	5	100	15.00		
Roe, Sam	30	20	12	10	5	5	5	5	92		12.00	13 80

FIG. 1. FORM FOR COMPARING ABILITY OF DRAFTSMAN.

The percentages here shown seem just right for the place where they are in use, but probably other offices would desire different relative values or a change in the headings, but, however used, it is more satisfactory than the arbitrary judgment of one man.

Practical Letters from Our Readers

A Round Table Discussing Details of Modern Machine-shop and Drawing-office Methods, Practice and Economy

WE PAY FOR USEFUL IDEAS

An Improvised Leveling Rig

Anyone who has had urgent use for a spirit-level when one was not at hand, or within borrowing distance, will appreciate the value of the makeshift herein described.

We are so accustomed to depend absolutely upon our modern tools and instruments that when without them we are at a loss to know what to do. At such times a slight acquaintance with the implements of the ancients will often suggest a way out of the difficulty.

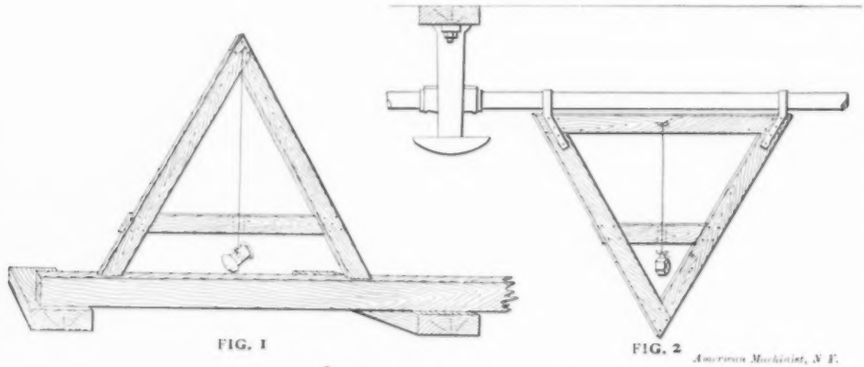


FIG. 1 FIG. 2

American Machinist, N. Y.

AN IMPROVISED LEVELING RIG

An excellent substitute for a spirit-level, the principle of which is older than the Pyramids of Ghizeh, may be improvised in a few moments from a few light strips of wood, a bit of twine, and any convenient weight.

Make an A-shaped frame, Fig. 1, of a size suitable for the job, out of any light stuff. Have the cross-piece at about one-quarter of the hight of the frame. From the apex of the frame suspend a weight sufficiently heavy to keep the twine taut. The twine should be long enough to allow the weight to hang below the cross-piece of the frame.

Stand the frame on something solid, bring the plumb-bob to rest, taking care that the line does not touch the cross-piece, but hangs just free of it; mark on the cross-piece where the line crosses it.

Now reverse the position of the frame, taking care to have the legs placed where the opposite leg was before, and mark again where the plumb-line crosses the frame. Half-way between these marks is the point where the plumb-line must be for both legs to be on a level.

If a fine line and a heavy weight are used the degree of accuracy obtained with this contrivance is very satisfactory indeed. By slightly altering the construction of the frame overhead work can be leveled with equal facility.

If the modified frame is provided with hooks, as shown in Fig. 2, it makes a very handy instrument for leveling shafting.

Albany, N. Y. C.

Die for Small Armature Work

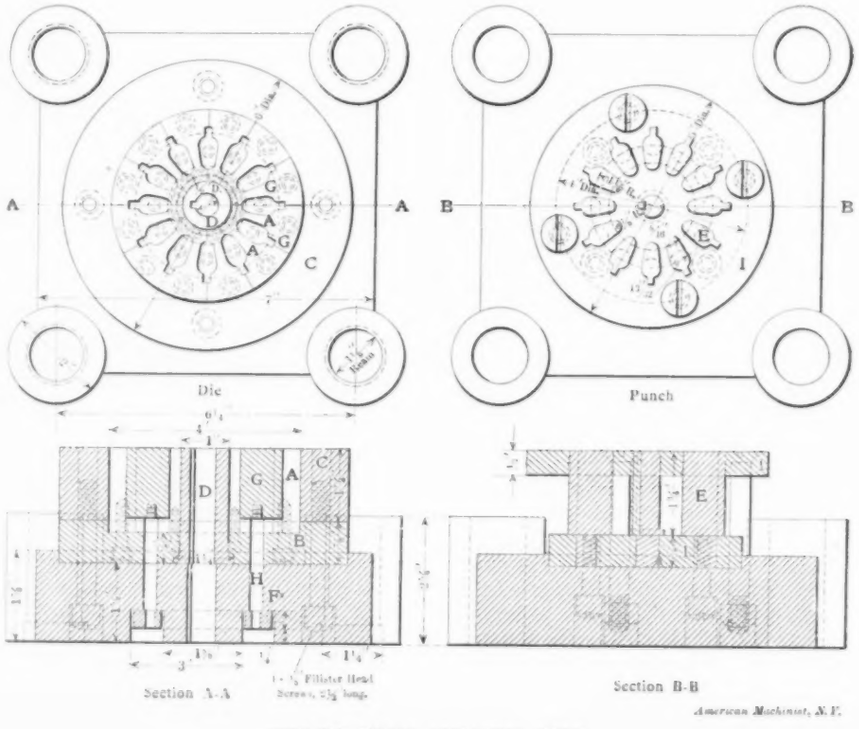
A compound die, for repunching small armature sheets, is shown by the sketch. The sheets are first blanked on another die, the proper outside diameter, which in this case is three inches. They are afterward placed on the die shown, being located by a ring 1/16 inch thick (not shown) on the lower half of the die, and the center hole and slots punched.

The sections *A* are first machined to the proper length and included angle and, being held together by a ring of suitable size with set screws in the periphery, are then turned to fit the assembly plate *B*. After being tapped for screws, as shown, they are mounted on the plate, turned to fit the support ring *C*, and bored for the center bushing *D*.

The die, as so far completed, is then mounted on the index head of a milling machine and small holes drilled in the center of each of the slot radii after which counterbores of proper size are put through to remove the surplus metal. The die is then taken apart, the sections placed in milling fixtures and a formed cutter used to finish the outline. By this method one set of cutters is sufficient as most of the stock is removed by the drills and counterbores.

The punches *E* are turned in lengths for two, a shank on each end, milled on centers with a formed cutter and then cut in halves.

The punch and die are alined by four 1⅛-inch pins in the corners, the holes



American Machinist, N. Y.

DIES FOR SMALL ARMATURE WORK

for these being shown in the blocks. The die is designed to be used on a press with a lower "knock-out," the knock-out ring *F* being connected to the shedder pieces *G* by the pins *H*, giving a vertical movement of one-quarter inch.

When the die is sharpened the ring should be held at the highest point to preserve this amount of movement. A die constructed on these lines has the advantage over a solid die of being far easier to repair in case one of the sections should break, as the section can be removed and a new one substituted in a short time. When making the die it is advisable to make three or four extra sections to be used for repair purposes as the cost at that time will be small.

The stripper plate *I* can be operated by means of rubber, or helical springs can be used, as shop conditions determine.

The further construction of the punch and die is shown by the plans and cross-sectional views and requires no explanation.

Boston, Mass. J. E. MAY

Tool for Laying Out Bolt Holes in a Circle

The accompanying illustrations show a device for laying off circles for bolt holes and other purposes.

A and *B*, Fig. 1, are two arms, pivoted at *C*, and each provided with a scale, the ones shown in the photograph being divided in inches and sixteenths. Two pieces *D* slide on these arms, each piece *D* being provided with a center punch mark clearly shown at the inner upper corner. Attached to one of the arms *B* is a sector *E* provided with holes in order that the arm *A* may be located at different points by means of the pin *F*.

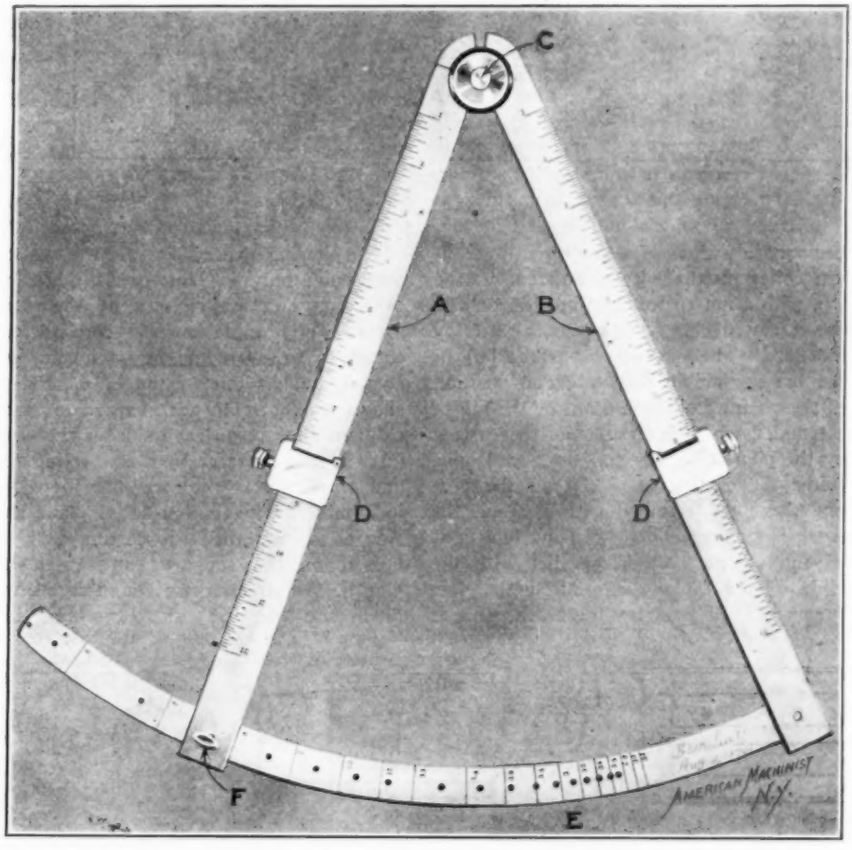


FIG. 1. TOOL FOR LAYING OUT BOLT HOLES IN A CIRCLE

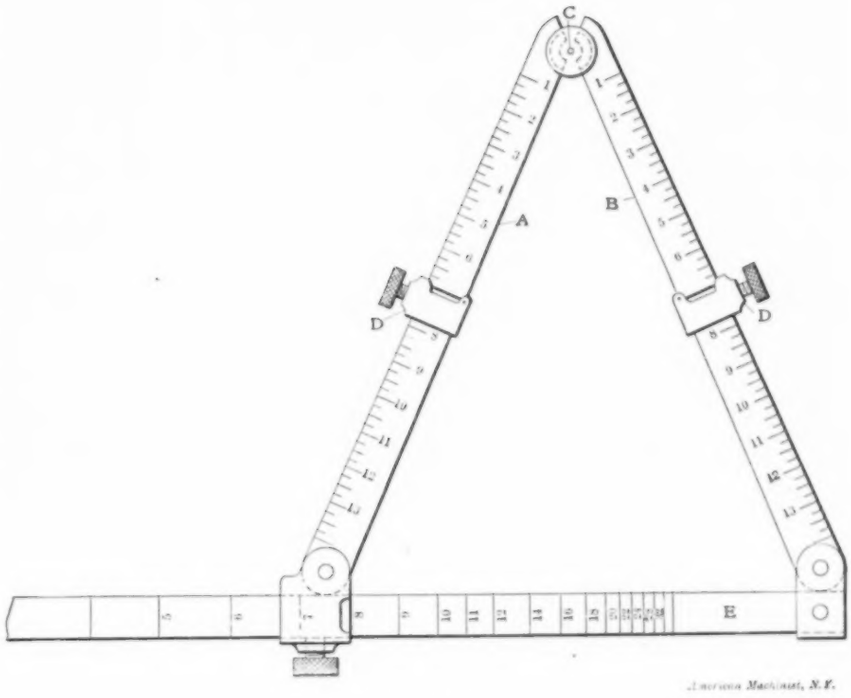


FIG. 2. TOOL FOR LAYING OUT BOLT HOLES IN A CIRCLE

In using this tool, set the sliding pieces *D* at the required radius, and swing the arm *A* out until the index on *E* indicates the number of spaces into which it is desired to divide the circle. Drop the pin *F* into place, holding *A*, *B* and *E* rigidly in position, and set your dividers to the two center punch marks on sliding pieces *D*. This distance is the chord for the required number of spaces on the circle of the given radius. In practical operation this is used for determining the position of bolt holes.

It is not necessary that the sector *E* should be curved as shown; it may be straight as in Fig. 2, the change in form being compensated for by change in location of the holes, or graduations on *E*. Neither is it necessary that the scale on the arms *A* and *B* be in inches or fractions thereof. They can be made if desired to represent inches to any required scale, as for example, 6 inches on the scale to represent 1 foot actual distance. When used in a pattern shop there would preferably be no scale at all, the distance of the sliding pieces *D D* from the center *C* being laid off with a single-shrink or double-shrink rule, as found desirable, thus giving the required chord between the points on *D D*, with allowance for shrinkage. It is also evident that *B* and *E* could be made of the same flat plate, the arm *A* being a section of flat plate sliding thereon, but pivoted at the same point *C*.

In actual practice, as in spacing the bolt holes for a cylinder, say, 60 inches in diameter, the center is often inaccessible, but the requisite number of divisions having been determined on and the distance between them transferred to the dividers by this tool, it is then possible to space the circumference of the cylinder with the dividers without bringing the setting instrument anywhere near the cylinder.

GUSTAV J. LUCK.

West Allis, Wis.

Annealing Iron Castings

I would like to hear, through the AMERICAN MACHINIST, of the cheapest and best way of annealing small gray-iron castings. The method in practice in this locality is to pack the castings in boxes with charcoal or some filler and seal the boxes with clay, heating them in a furnace from 30 to 48 hours, then letting them cool with the furnace, the furnace maintaining a heat of about 1500 degrees.

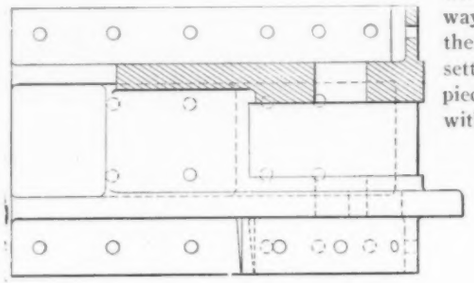
Erie, Penn. A. H. STEEL.

Some Difficult Machine Operations with Limited Facilities

We had a large amount of work for the U. S. Government improvements on the Ohio river and in the course of our work we struck some pretty ugly propositions. Figs. 1 to 3 show one of 75 steel castings weighing 500 pounds which gave us the most trouble. There were two operations that required special tools, namely to bore oblong hole *A* Fig. 1 and to plane or mill the arc *B*. Our shop equipment consisted of lathes, planer, shaper, universal radial and upright drills but we had no milling machine.

First we planed and then drilled the bottom of the casting in a jig. It then went to 36-inch lathe to have the roller pin hole *C* bored. To do this the cross slide of the lathe was removed and a cast-iron plate planed on top and also where it rested on wings of the carriage. This was bolted fast, the vertical distance from surface of this plate to centers of lathe being the same as the distance from bottom of the casting to center of the required hole. The first casting was then set on the plate and carefully alined to the required position. After scribing the location of two of the drilled holes as far apart as possible the casting was removed and the plate drilled, reamed, and short dowel pins inserted. This located all the castings for boring. We next machined the oblong hole *A*. This, as will be seen, is bored through both sides. For this operation we made a boring bar like Fig. 2, also a sliding table for the radial drill, part of which can be seen in lower left-hand corner of Fig. 4.

The means employed to set the casting true with the bore was a steel post screwed into the top of the sliding table



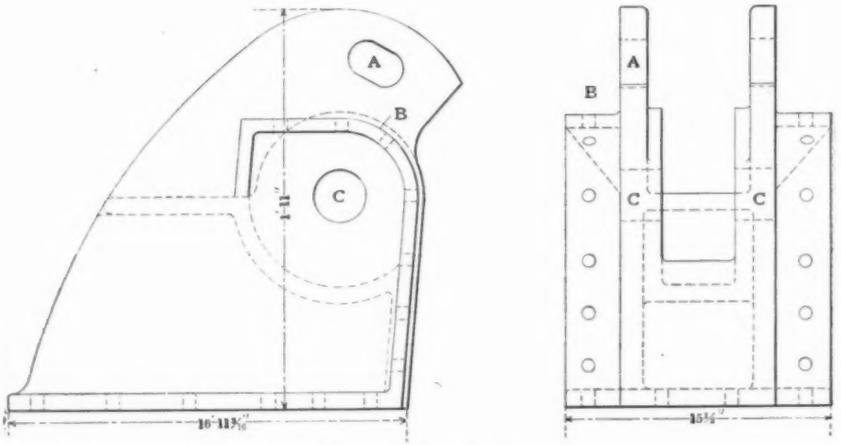


FIG. 1. THE CASTING

and square with the face of it, with a conical collar on the bottom and one at the top, with a nut to force it into the hole in the casting. This sets the casting true by the bore. The post shows at the left of the boring bar in Fig. 4. The position of the oblong hole is laid out by the aid of a templet, which is located on the casting by the planed bottom and the bored hole. After the casting is placed on the post and the cones clamped with the nut, the work is swung around until the long axis of the oblong hole is parallel with the slide of the table. A small angle plate forms a fixed stop for the work; this is simply held to angle by small bolt and is all the clamping required.

Fig. 3 shows the outline and method of machining the oblong hole, the pilot of the boring bar being shown in cross section. A 1¼-inch drill is first run through both wings, then the boring bar is placed in the machine, the pilot entered in the bushing at the bottom (see Fig. 4), the feed is put on and the cut run through both sides removing the crescent-shaped piece shown by dotted lines in Fig. 3. The bar is then withdrawn, the slide moved the opposite way and the cut repeated. After setting the stops for the first piece no further settings were required for subsequent pieces. We finished eight castings per day with this rig operated by a boy.

The boring bar is made to cut on the end only. This was done to overcome lack of rigidity of the drill press. The angle on the end of the cutter is to overcome any tendency to crowd the bar out of the hole. Fig. 5 shows the portable arc shaper we made to plane the arc on each side of the casting. It was operated by a connecting rod and crank pin in the face plate of a 20-inch lathe. This was used to plane one side as shown, then the casting was reversed on the support and other side planed. In practice we found it best to finish one side of 15 or 20 castings, then

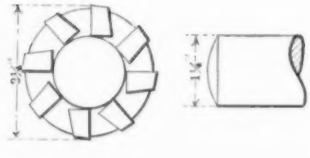


FIG. 2

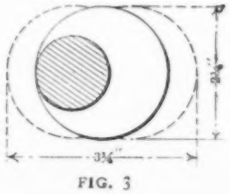


FIG. 3

THE BORING BAR AND THE OBLONG HOLE

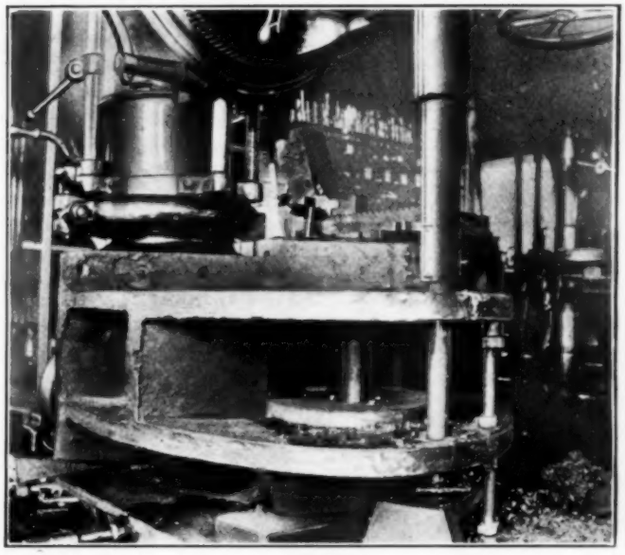


FIG. 4. BORING THE OBLONG HOLE

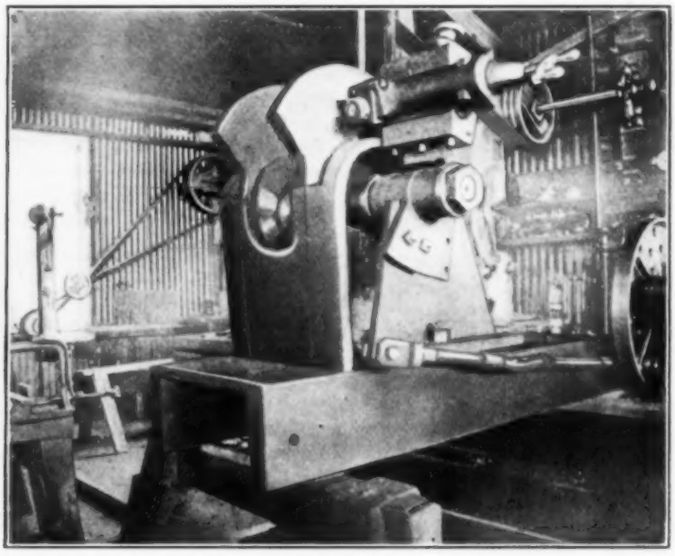


FIG. 5. SHAPING THE ARC

change to the other side. As will be seen, the tool swings on a shaft which is a sliding fit in the bored hole and held solid by a large nut at the other end. This made it easy to get both sides uniform and to correct arc. It was not necessary to set the casting true with the lathe, as simply sliding the shaft through the bored hole and putting on the nut brought the tool into proper alinement with the work. Vertical and horizontal slides permitted any depth of cut and feed. We could carry a heavier cut on this rig than our regular 21-inch shaper would pull. The tool block swings at an angle. This was done to get the tool point in advance of the slide without excessive overhang.

With this rig we could finish six or seven castings per day, and the fact that the Government inspector passed on every day's work without a kick is proof that the tools were all that could be desired. In fact the operator of this device considered he had a cinch while the job lasted. This portable tool weighed 50 or 60 pounds complete.

Claysville, Penn. J. M. KING.

Sprocket Cutter Grinding Machine

Having a large number of sprocket cutters to keep sharp and no means of grinding them quickly and accurately, the special attachment here described was designed to meet the needs of the work.

When a large cutter is sharpened on an ordinary grinder it is necessary to set the cutter three times, once to grind across the point of the teeth, and once to sharpen each edge which cannot be reached by the first setting.

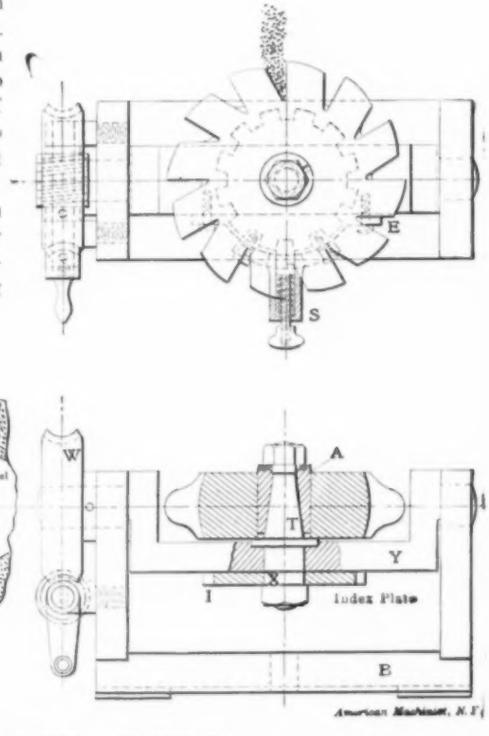
The drawing shows a scheme which will allow a cutter to be ground radially and the whole cutting edge sharpened at one setting. It also provides a means for indexing the cutter accurately and thus keeps the sprocket cutter teeth the same length. Hence all the teeth cut equally and this lessens the chance of breaking a tooth.

In laying out the fixture care was taken to pick out the largest cutter in stock and make the yoke *Y* wide enough to accommodate it. This also determined the length of the base *B*, which was made to slide in the slotted grinder table. The taper stud *T* fitted into the yoke and was provided with a square shoulder *X* to accurately locate the index plate *I*. The split bushing *A* was made to fit the hole in the cutters, and by tightening the nut the cutter can be locked to the stud. The stop *S*, shown in the top view, worked into the notches in the index plate *I*, making an easy means of indexing the work. An index plate had to be made for each cutter having a different number of teeth. When cutters of an odd number of teeth are ground it is necessary to shift the stop *S* radially on the circular projection *E* until the correct position conforming to the teeth in the cutter is reached. Then it is clamped in position.

At the left end of the fixture is shown a worm wheel which provides an easy method of rotating the cutter from position 1 to position 2 and 3 and grinding the whole cutting edge.

The method of operating is to attach the cutter to the stud *T* and line up the edge of the tooth with the index plate. This is easily done by having radial lines marked on the index plate. The grinder table is fed forward to the right position, the tooth rotated, the table fed back, the sprocket indexed, and the operations repeated. The time of grinding is reduced to one-third the time originally consumed, and a much more accurate job obtained.

The same fixture may be used for grinding all other forms of gear cutters, and by providing the requisite bushings it is made available for a wide variety of work. C. C. MYERS.



SPROCKET CUTTER GRINDING ATTACHMENT

Discussion of the Previous Question

Letters from Our Readers Showing How Many Men of Many Minds Look upon Various Subjects Opened up in Previous Numbers

WE PAY FOR THESE ALSO

Annealing Air Hardening Steel for Drawing Dies

On page 277 of the AMERICAN MACHINIST, R. Eader asks how I anneal air-hardening steel for drawing die. The steel we are using we buy from the manufacturer annealed; it can be bought at an advance of about one cent per pound for annealing.

Air-hardening steel that has been hardened, or has not been annealed, I anneal in the following manner: Cut the pieces as near to the required size as possible at the forge; provide a piece of pipe of a convenient length to handle; fit it with a screwed cap on each end; in one cap drill a small vent hole; screw one cap on the pipe; then fill in some burned bone, say for about 2 inches; then put in a piece of steel, keeping it away from the pipe and filling around and over it with bone; then another piece until I have all the pieces in or the pipe full. I then screw on the cap and it is ready for the furnace. If burned bone is not at hand use dried sand, or coal ashes and salt. About one part of salt to ten of ashes will anneal very soft if properly heated, but sometimes it leaves a hard scale over the steel.

When properly packed put the pipe in a muffle or furnace and heat it to about 1200 or 1500 degrees, Fahrenheit, a bright red, and let it heat long enough to insure heating through thoroughly. I use a hard-coal muffle and heat a 5-inch pipe five to six hours, with the furnace maintaining a heat of about 1500 degrees, Fahrenheit. I then draw the pipe and bury it in a box of lime, having about six inches of lime around the pipe, or if possible I let it stay in the furnace and cool down with it. The furnace is charged every second day and I manage to get my steel in so it cools with the furnace.

I do not know of any cheap and easy way to anneal air-hardening steel. I would like to hear from anyone who does.

I have the best results, when making drawing dies, by cutting the blanks from the end of bars, getting a bar large enough in diameter to make the blank, so as to get the grain of the steel running parallel with the work. The die stays smooth longer, and I believe will take a higher polish.

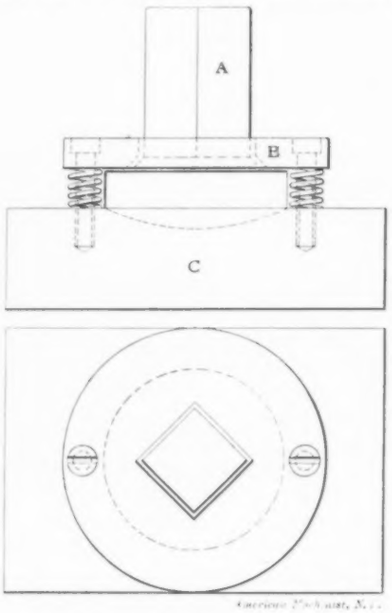
The oil we are using is an oil put up by the Standard Oil Company and known as mineral lard oil. I believe it is a mineral oil containing a high percentage of fiber oils. It adheres well to the work and is not expensive.

Erie, Penn. A. H. STEEL.

Flattening Punched Blanks

I quite agree with L. F. C. George on page 29. There should be no difficulty in getting flat blanks from flat stock if the punch and die are kept perfectly flat, but you cannot get flat punchings from the coil, even if you use spring strippers and spring ejectors unless the material is soft.

I have found some difficulty in striking a flat blow on large blanks owing to the presses being out of square (the bed with the slide) having, in many instances, to pack one side of the bottom block. I have successfully overcome this by making a flattening tool, as shown in the line cut. It is a "cup and ball flattener,"



FLATTENING PUNCHED BLANKS

the punch adjusting itself to the bottom die when the blow is struck.

The blank required to be flattened is 0.060x4x6 inches. In order to strike a flat blow over a surface this size you can easily see that the faces of punch and die must be in perfect alinement, otherwise you will find your blank several thousandths thinner on one side than the other.

A is the ball fitting the socket in *C*. *B* is the keep ring supporting the top flattener *C* by two screws. The two spiral springs are put in to stop all rattle, freedom being given in the holes to allow the flattener to adjust itself readily. It is not necessary to show the bottom flattener, as that is an ordinary flat block.

JOHN S. HAMILTON.

Glasgow, Scotland.

Another Method of Graduating Tailstocks

I have noticed considerable discussion in your paper lately about marking the tailstocks of lathes so that their centers can be quickly and accurately brought in line with the headstock centers. We have a simple and accurate way of doing this. To get the tailstock center in line with the headstock center we take a piece of round stock as long as the lathe will take between centers, carefully center each end of it, place it between centers and turn off the end which is on the tailstock center for one inch, taking just enough stock off to clean it up. Then we clamp a tool in the tool post which has a rounded point which is fed up by the crossslide until a piece of thin, stiff paper which is used as a feeler slips stiffly between it and the turned off portion of the shaft.

The crossslide is left in this position. Then remove the shaft and feed the carriage up toward the headstock until it is nearly opposite the headstock center; place the shaft on the centers again, but reverse it so that the turned portion is on the headstock center with the round-pointed tool opposite it. Try the paper feeler between this point and the turned off portion of the shaft. If the feeler fits the same here as it did at the tailstock end it shows the centers are parallel to the ways; if it fits tighter it shows that the tailstock center is too far toward the front of the lathe; if it fits looser the tailstock center is too far toward the back of the lathe. By repeated tests as above the tail center is set in line.

Now to mark the tailstock, nick it in back where the upper and lower portions come together in the usual way, after seeing that both adjusting screws are up tight. Then make a scribe or light chisel mark along the tops of threads of each of these and a mark in the side of the tailstock to coincide with these marks on the threads of the screws. In this way you have a rough micrometer adjustment, as the nicks in the back of the headstock will show approximately when the center has been brought to the correct position and by adjusting the screws so their marks coincide with those on the tailstock a close adjustment is secured.

I think this is a better and cheaper way of marking a tailstock than any that I have noticed so far.

Govans, Md. F. E. FICK.

Ways of Hunting a Job

Mr. Osborne's observations at page 264 remind me of several instances along that line which came to my notice through a friend, and tend to show that there are as many diversities and knacks about job hunting as in any other sphere of activity.

A certain large machine works in Philadelphia maintains an office especially to employ help. This place is closed after a set hour every morning, and the uninitiated who are seeking employment so mnly file away until the next day. The works is surrounded by a high fence, the passing of which would appear almost impossible. However, if one is wise and hangs around one of the large entrance gates where the freight goes in and out, he can slip past the gateman either behind or on a dray, and once inside can pursue the quest for work with much more chance of getting it than by waiting at the office.

The procedure after passing the gate is to successively hunt out each of the machine, fitting and erecting foremen and apply for a job. If one of them should be in need of a man, and he likes your general make-up, you will be given a trial. This way of hiring men probably obtains because of a natural desire on the part of the foremen concerned to do their own hiring, instead of letting a clerk in the office shove anyone who calls himself a machinist onto them.

One other good point about this self-installed and automatic system is the fact that only men who are determined to get a job if there is one "going," and have grit and horse-sense enough to pass the gate ever reach the foremen. This weeds out the large majority of careless job hunters who float about looking for something easy.

An advertisement once appeared in the paper for two machinists, and about 15 or 16 men answered. They crowded into a small room to await the pleasure of the person in charge of the hiring. Just before he came in two men of the same general appearance as those already in the room entered by the same door as they and stood at the back of the rest. Although no one in the room had removed his hat, these two immediately did so, and just then the manager entered the other end of the room, and glancing quickly over the crowd, signaled those two to step up. This they did and were quickly hired and put to work, while the rest were allowed to go.

So it goes! One man may be just as good or better at his trade than another, and yet that other by the judicious use of a little common courtesy will land a job nine times out of ten as compared to the one who is so sure that he is as good as the best that he acts in a way the real "best" could not act.

Ottawa, Can. N. E. RALSTON.

Present Practice in Drafting-room Conventions

Referring to Entropy's article on page 109, is not the glossy side of tracing cloth frequently used because of the ease of erasure, and because the gloss can be put back on the cloth by rubbing with pulverized pumice as stated in the AMERICAN MACHINIST some years ago?

As to changing tracings: The system of numbering drawings may provide for the addition of a letter every time a tracing is changed. Thus, the original drawing number may be 999; when changed the number may be 999-A. A second change may be indicated by either erasure or cancellation of the *A* by drawing lines through it and adding *B*. The card catalog record of the drawing will show what the changes were, and the date of making them may be indicated by writing the date under or after the letter. If cancellation and not erasure of letters is used in making further changes, the drawing will bear its own record and a foreman can tell at a glance whether the blueprint shows "that change that they made three months ago" or not. The principal advantage of this method, however, is that by reference to the drawing list or catalog, or list of drawings embodied in the specifications covering outside work, the foreman can tell definitely whether or not the print is up-to-date. E. W. FISKE.

Unproductive Time

The editorial at page 152 with the above title calls to mind the article published some months since describing an elaborate electrical equipment, installed in a large machine shop, for the purpose of detecting and measuring this idle or unproductive time. This scheme is too elaborate and too expensive to permit its use in any but the largest shops. What is needed to bring such a record within the reach of the moderate-sized plant is some device of low first cost that can be applied to any machine independently of all others, and be operated with the minimum amount of care and expense.

I have in mind a device which was originally designed for another purpose, but which can be modified to fill these conditions without adding to its cost. It is now in operation for the original purpose at a cost of about 3½ cents per day,

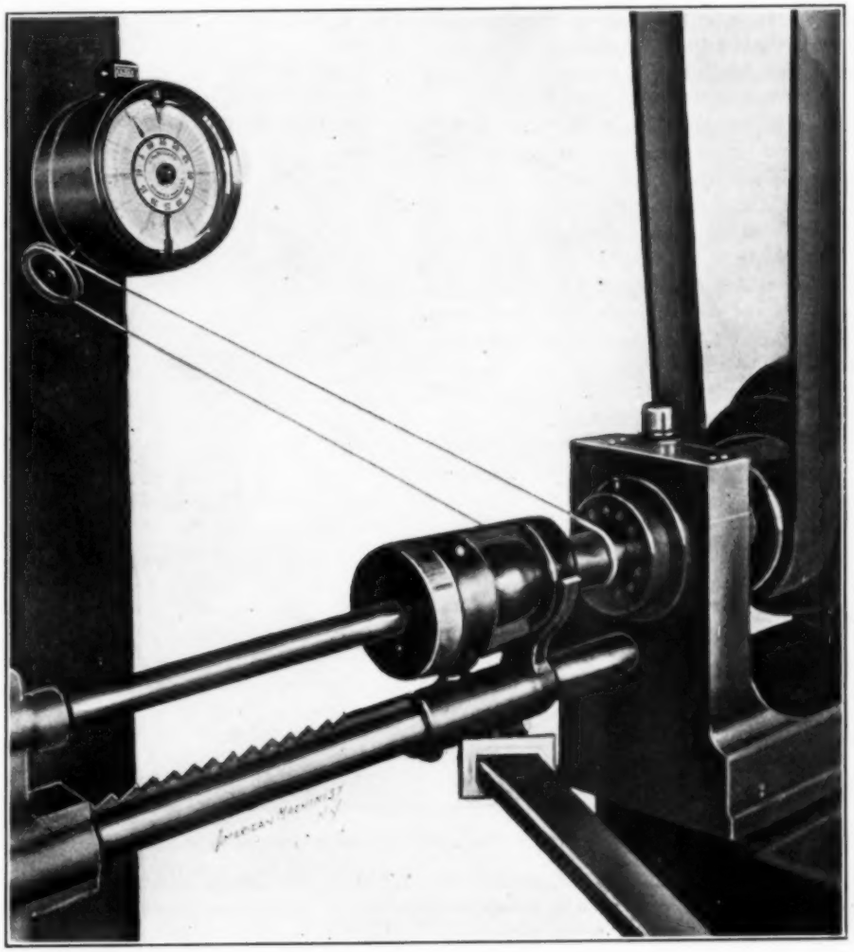


FIG. 1. INSTRUMENT FOR RECORDING TIME ATTACHED TO A HAND SCREW MACHINE

including interest on investment, up-keep, and the supply of record cards. So small an increase as this in overhead charges would surely be more than offset by the increased earnings of any machine to which such a device would be likely to be applied. The working parts of the instrument are inclosed in a substantial brass case about 4½ inches in diameter, by which they are protected from dirt and injury. The essential parts are a clock movement, which rotates the record card at a uniform rate, and a train of gearing, driven from the machine, which operates a punching device. It is not necessary that the instrument be driven at a constant speed, as a range of speed from zero to about 1000 turns per minute is already provided for. This feature would be an advantage, in that for such machines as a lathe, for instance, a table of speeds could easily be prepared that would show whether the proper speed was being used for a given diameter of work, the record being readable while the machine is in motion.

The record is made by punching a circular card at frequent intervals, with a pointed stylus. This record cannot be erased, and it would be almost impossible to falsify the record by punching by hand without immediate detection. The surface of the card is divided by circular lines into spaces representing hours, and by radial lines into spaces representing minutes. Spaces are provided for a continuous run of 12 hours. The stylus starts at the outer edge of the card, and moves one space toward the center every hour. The card makes one complete rotation every hour. The punchings vary in spacing according to the speed of the driving mechanism, and may be as close together as four per minute. The punchings in the card indicate the working time, and the blank spaces show the idle time in hours and minutes. A card may be used for a day's run, or a separate card may be placed for each job, keeping time for the whole day, or for each job separately. Blank spaces on the back of the card at the center provide for the job number, and a small amount of other information. The cards may be readily placed on file, and so furnish means of comparison between old and new methods. The only attention required is to wind the clock each day, and insert a new card, which takes only a moment for each instrument. The instrument is small enough to be mounted directly on the machine, and may be driven either by belt or gearing.

The illustration, Fig. 1, shows the recording instrument attached to a Pratt & Whitney hand-screw machine. The instrument itself was screwed to a convenient post at the rear of the machine; the drive in this case is by a small grooved pulley and a piece of cotton cord for a belt. A very simple arrangement, but filling every requirement..

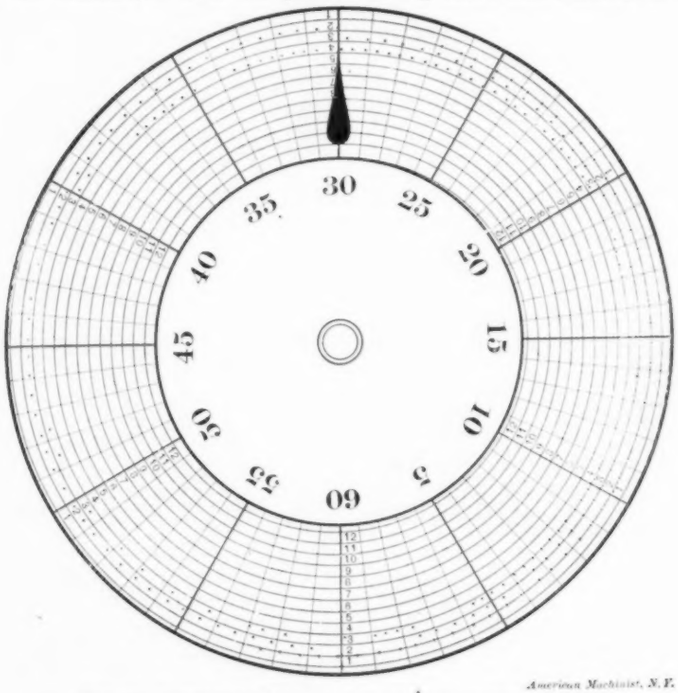


FIG. 2. SPECIMEN DIAL FROM RECORDING INSTRUMENT

At the time of taking the photograph for the half-tone the clock indicated 55 minutes past 2. The minutes are read on the edge of the central disk against the pointer at the top of the face, and the hour showing through the small opening at the base of the pointer. The radial lines for the minute divisions show with a heavier line every five minutes. The circular lines for the hour divisions also show plainly.

A sample record card is shown, Fig. 2, that was taken from this machine. The recording dial or card is rotated in the same direction as the hands of a clock. Therefore to read the record, begin at the outer edge and read contraclockwise toward the center. This record shows the first puncture at 57 minutes past the hour, then an uninterrupted run of half an hour when a stop of three minutes was made. The next puncture is at 31½ minutes past the hour, with another run of 29 minutes, again a stop of three minutes; a further run of 27½ minutes brought the completion of this job.

There is then a space of 35 minutes that is blank except for one or two punctures at intervals, which show where trial cuts were made in setting up for another job. After the setting up the work goes on with but few stops, as shown by the line of punctures. The punctures are now closer together indicating a higher spindle speed, and so a smaller diameter of stock, or in some cases, stock that can be run at a higher speed. Any change of conditions then that permits increased speed on a particular piece of work shows at once, so that a comparison between any two lots of the same piece is easily made. The same thing is true, in general, in the application to other machines. The idle time is always clearly shown, also the changes in speed during the working time.

Springfield, Mass. F. H. BULLARD.

Cutters with Inserted Helical Blades

William H. Taylor in his article about new high-speed milling cutters on page 1 is wrong in stating that George Bechtol was the first who made milling cutters of this type with inserted blades.

Cutters of the type and sizes described, with helical inserted blades were made about as early as 1884-5 by Friedrich Wannieck, mechanical engineer and proprietor of the well known steam engine and machine works at Brünn. He made and used these cutters with great success for his own manufacturing purposes. His present address is Möhlstr. No. 32, Munich.

The "Erste Brünner Maschinen-Fabriks-Gesellschaft," which comprises now the former "Wannieck Works," will certainly be able to give further details about the matter.

Bielefeld, Germany. ERNST REIN.

Annealing and Hardening Steel

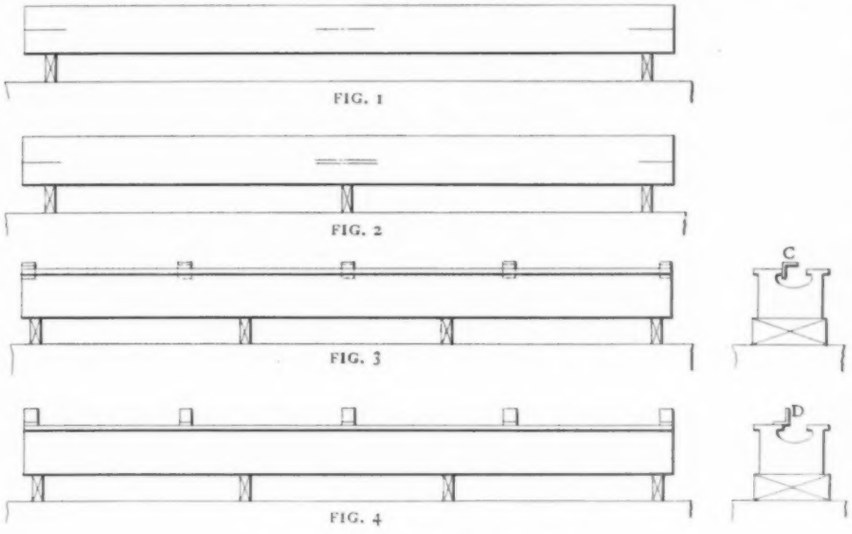
In response to the query on the above subject at page 277 I submit the method I have used. Heat the steel to a bright red and pack in any good nonconductor of heat (I have used soft-coal soot, but fine, dry lime or ashes will do just as well, I am told) and allow to cool very slowly. The slower the cooling the better the job seems to be.

New York. E. A. DIXIE.

Accurate Planing to Avoid Unnecessary Scraping

At page 683, Vol. 31, Part 2, L. F. C. George ventures a few remarks on accurate planing and, as an old planer hand I may be able to help him out. Apparently his principal trouble is caused by deflection owing to the elasticity of the castings handled. Taking the two castings, one of which has been exposed outside in the yard to all kinds of weather, say, for six months and the other fresh from the foundry a couple of days old, which has cooled down, to the atmospheric temperature meanwhile, and set up these castings, plane them in exactly the same manner, allowing for deflection and deformation of the casting caused by machining and we obtain practically the same results.

Mr. George speaks of pulling the castings down 1/32 inch at both ends when planing to get them reasonably straight, whereas they would come out 1/32 inch hollow or low in the center when planed in their natural position; this would have the opposite effect to that desired, seeing that if the castings were planed and were 1/32 inch hollow in the center, then the ends allowed to spring up the 1/32 inch pulled down when setting, making the defect 1/16 inch altogether, so that it appears this should read *packed up* at both ends 1/32 inch. This would neutralize the defect of 1/32 inch already existing, probably in the machine, the result being a casting reasonably straight.



TESTING LONG LATHE BED FOR SPRING

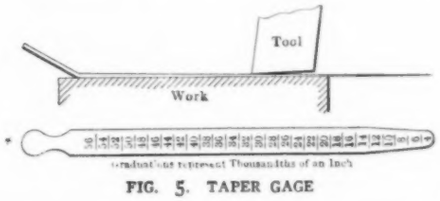


FIG. 5. TAPER GAGE

In speaking of the natural position of a casting, it is assumed that Mr. George means the position of the casting when lying, say, on the surface slab and supported at those points on which it will finally rest.

With the casting roughed out entirely so that practically no more physical deformation will take place as the result of machining, and before the finishing planing it should be tried on the surface slab for deflection. This in some castings is considerable and the amount may be ascertained in the following manner: First support entire weight of casting at the two extremes as in Fig. 1, which will cause the center of the casting to drop if it is not perfectly rigid in itself. Strike a line with the surface-gage at the ends and along the center as in Fig. 2 until the casting just touches the end supports, all the weight being relieved. Test with the surface-gage to see that the ends have not been raised any, then strike a second line at the center. In some cases with a casting 20 feet long the two center lines will be 0.25 inch apart so that it may be said that the deflection is 0.125 inch. This is only an approximation and while it is good enough for a great many purposes it is not good enough for precision work, for if the casting is turned over and the operation repeated the result in many cases will be different and yet each time the casting is in a natural position.

Take for example a lathe bed 20 feet long, which is not rigid enough to prevent deflection when supported at the center or the two extremities. Having performed all operations likely to cause any physical deformation or change of structure, proceed as follows: First find approximately the amount of deflection, set up the bed on the surface slab, supporting it at the same points as it will rest on in its *final* position. Then fix the five pieces, Fig. 3, to a machined face if possible, the faces *C* being parallel to the surface slab, testing them for accuracy with a dial indicator, or if this is not available, with the straight-edge and surface-gage. The next thing is to see that the bed is in alinement, which can be done by fixing the pieces, Fig. 4, at right angles to the base setting them in the same manner. If a right-angled surface slab of sufficient dimensions is not available, the faces *D* can be set within very close limits with a straight-edge. The bed should now be set on the planer table and supported in the same way, with any additional supports which may be necessary to prevent deflection of the planer table when overhanging its own bed. The pieces fixed to the bed to be planed are now set in line from the tool box with the indicator or the taper gage, Fig. 5, slipped under a parting or other square-nosed tool as shown. The readings being 0.002 inch it will be seen that by this means very good results may be obtained. When set in this manner it will be found that even with a machine which has small defects in the way of alinement a casting which is flexible may be planed nearly as true as the surface-slab on which it was set before planing; in any case the troubles caused by flexibility will be eliminated if the necessary care is exercised in setting it.

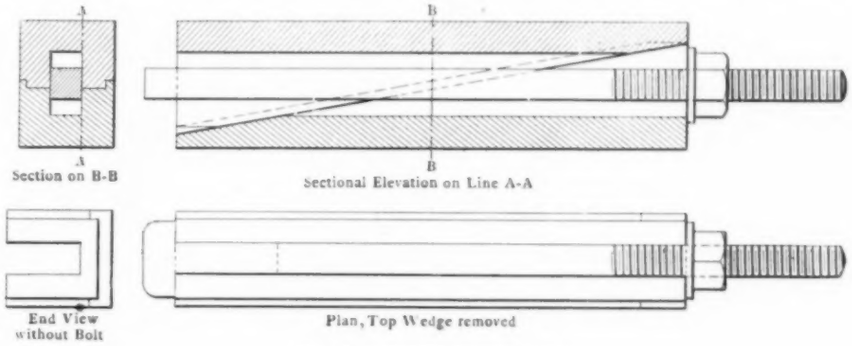


FIG. 6. FOLDING WEDGE SHIM

In the bolting down of work on the planer Mr. George's practice varies considerably from my own experience. Certainly many planer tables can be sprung by careless bolting down, but that should not prevent the planer hand from securing the work as rigidly as possible to the table. First stop the work so that it can-

not move in a lateral direction even without the bolts, then using as few bolts as possible pull the casting down tightly without springing, making the work and table resemble one piece, care being taken to have the bolts close to the work and to extend the base of the packing pieces so as to touch the bolt and cover as much of the surface of the table as can be spared.

When bolting down, shims of the folding-wedge type, Fig. 6, should be used, so that if the dial indicator or taper gage show that the work is being sprung down, the bolt of the folding wedge can be tightened and the work raised to its normal position. GEORGE BILHAM.

Woolwich, England.

Recalescence Point in Hardening Tools

W. Osborne's article on page 215 of the AMERICAN MACHINIST, brought forth some facts in regard to the critical or recalescence points of steel, which are non-magnetic and absorb heat. While these are new ideas to some, they are to others new only in name, as was evidently the case with the expert hardeners that Mr. Osborne refers to as stating that they could tell what the hardening heat of a piece of steel was, even if they did not know the carbon contents, and it is hard to give an intelligent reason for this claim, even though it is true.

I sometimes imagine that it is possible to see to a considerable depth into a block of steel when it has reached the absorption point, and I am able to tell when the steel has reached the proper hardening heat in this way. As near as I could tell anyone how to look for this heat, would be, to watch the steel very closely (not continuously), and when it arrives at a heat that looks clear and clean, almost a transparent heat, then you have the steel at the absorption heat. This is precisely what the experts have been doing for years, without the aid of the pyrometer.

I have often shown this heat to mechanics and invariably all they could say was, that it is a pretty heat. Therefore I am convinced, that it is almost impossible to describe the heat so that anyone could take a piece of steel and get the precise heat without the aid of the pyrometer.

With this instrument an inexperienced man will not be able to get the proper heat of any other piece, than the one connected with the pyrometer. Therefore, I do not see how science will be able to produce anything that will tell the inexperienced man when the steel is being heated properly and when it arrives at the proper heat for hardening. If we could arrange to take the temperature of each piece, then anyone could heat the steel for hardening any given tool with a given carbon content, etc.

Now let us see what would happen if we had the positive information that Mr. Osborne asks for? We would go to one shop and find them using open-hearth steel, another would be using crucible, the other bessemer, and another basic. One shop would have a reamer to harden, the other a trimming die, another a drop-hammer die, another a tap, and another a milling cutter. All of these would be of a different size, shape and carbon content. Let us consider that the proper heat for the drop-hammer dies is 15 degrees above the recalescence point. Would it be the proper heat for the milling cutter? No, it would not, as it is sometimes necessary to heat tools more than 25 degrees beyond the recalescence point to get the desired results.

We may be able to produce some work on the automatic machine, but it is, and always will be, necessary to have a machinist somewhere in calling, to arrange the machine for the operator. It will also always be necessary to have someone who knows some of the non-explainable mysteries of hardening steel, wherever there is a variety of tools to be hardened.

If Mr. Osborne had said that he had an embossing die 3 inches in diameter, 1½ inches high, and that the impression had to stand a pressure of 600,000 pounds on a space ½ inch square, and the impression must be in as good a condition after hardening, as it was previous to hardening; then I would say this, heat slowly, until the recalescence point is reached, then raise the heat to at least 15 degrees above this point.

There are many tools on which it is impossible to get the best results when working within 25 degrees of the recalescence point. As an example of this, let us take a file. This is something that is in use in every shop and we all know when we have a good one. Now it would hardly seem necessary, or even reasonable, to heat a 12-inch file with a certain tooth to 50 degrees more than we would a 6-inch file having a different tooth; but this seems to be what must be done.

The best file cutter I have ever met has a particular heat for each file and nothing but this heat would do. In order to get a demonstration of this heat it will only be necessary to take a few worn out files of different lengths and cuts, and break them to see the grain. It is best not to use more than three different cuts when breaking a dozen files, and it is better not to use more than two different cuts, as the comparison of the grain is easier to note.

While there are many things that seem mysterious in the heat-treating of steel, there is but little more mystery in being able to see the recalescence point of steel, than there is in being able to determine a driving fit with the use of calipers. The micrometer makes it easier, or enables the less skilled machinist to be sure. So it is with the hardener and the pyrometer, as this enables him to be sure that he has the proper heat, and that his eyes are not misleading him.

To produce the proper grain Mr. Osborne states that it is the custom of experts to say, "the proper heat to harden steel is at the lowest possible hardening heat." This applies only to some tools. In fact there are more tools hardened from 25 degrees above the recalescence point than there are at this point. Then again, as to whether it is better to allow the entire piece to come to the recalescence point, I will say that it depends entirely on what the tool is and what it is to be used for. If it is something in which the distortion is of vital importance, then it is a mistake to get the piece hot enough to harden to the center.

Some might say I am advocating uneven heating, but I am not, as I do not believe in uneven heating. On some tools I believe in having as little heat as is possible, otherwise we would be liable to lose the piece from distortion. I do not advocate this heat for any cutting tool where it is possible to use more heat, for we cannot get as good results from a tool hardened at the extreme low heat as we would to heat them beyond this. It is also absolutely necessary at times to heat higher than we want for quenching, in order to have the desired heat when the tool or die has been partly dipped, so as to control the distortion.

There are several elements that enter into or govern the heat a tool shall have previous to the quenching. The first is, to what heat can the tool be heated and immersed with safety? This comes ahead of all other desired results. The next is what amount of heat will be lost before the tool can be gotten into the water; and the last, but not least, is how much distortion will the tool stand and still be kept within the limits as to size? Many times not more than 0.0001 inch per inch is allowed before the piece would be worthless. All of the above must be cared for in the heating, and they are no uncommon occurrences in the handling of delicate dies and tools.

Davenport, Iowa. JAMES STEEL.

Chalking Tracing Cloth

Every little while I read an article in the AMERICAN MACHINIST, telling how to chalk tracing cloth. I worked over a drawing board for ten years, and at first, like all draftsmen, chalked the cloth, a dirty, dusty operation. I was much rejoiced and relieved when a fellow draftsman told me to rub the tracing cloth with a piece of chamois skin. This practice I have since followed, having no trouble even on coldest days in getting ink to flow, and avoiding chalk dust all over the room, and grit in my pen. Tell your men to get a ten-cent piece of chamois skin.

Philadelphia, Penn. C. L. P.

Expert Witnesses—Mechanical and Unmechanical

Whenever a murder trial of magnitude attracts the public's attention, we mechanics have our little laughs at the way the cheerful idiots called, in many cases by courtesy, "experts" make themselves ridiculous. I, for one, have heretofore held that it would not be possible to confuse even the average mechanical man, as these medical men are confused, but within the last few days I have changed my mind about this.

In a recent case, which, by the way, cost in the neighborhood of $200,000, a steel expert was called to give expert testimony regarding hardening and tempering colors. After answering questions which required the determining of the various colors all through the gamut of hardening and tempering it was developed by cross examination that the color expert was *color blind* and that he knew he was color blind before he was called to testify. His excuse for not mentioning his infirmity to the court was that it might cause comment.

Another expert was asked:

"Did you ever make a tool like that?"

"No."

"Did you ever see a tool like that made?"

"No, but I have been teaching my pupils (he was a professor in a technical school) for the past 20 years how to do that work and my ability has never, till now, been questioned."

In a case which was called in Glasgow, Scotland, some years ago, one of the chemical experts, an old man, was an exception, he knew his business. The attorney on the other side had been studying chemistry over night and next day he tackled the expert witness with:

"What would be the effect of a combination of so and so, and so and so, made in an absolute vacuum with the barometer at 33?" (or some equally foolish question).

"I cannot tell," replied Mr. Hunt.

"You can't tell! and why can't you tell?" said the lawyer.

"Because you ask a question somewhat similar to this, 'what is the distance from the Central station to Christmas?'"

It is amusing how these experts are sometimes led astray or rather allow their imaginations to run away with them. Some years ago there was a lot of talk in the technical press about deterioration of the steel rails made and used in Germany. Many theories were advanced to account for this peculiar "rotting," if I may use such a word. A friend of mine, who writes for the trade papers, sent an article on the subject to one of the foremost mining papers. In this article, which he wrote as a joke, never expecting anyone to take it seriously, he posed as an old German chemist. He described at length how he had discovered a minute microbe in the rotten steel rails. Examining it under a microscope he found that this microbe exuded a powerful acid from its mouth, which softened the steel and enabled it to bore its way into the rail.

An expert, high up in the steel industry in this country, and a rabid protectionist, read the article and cited it as a further reason why we should not import rails from Germany, as our rails might become innoculated with this dread microscopic rail driller and spread ruin throughout our railroad systems.

Experts often deceive themselves. A friend of mine, sporting editor of a New York paper, is very fond of inventing names. Some years ago an Irish wrestler came to this country and made good in various bouts. My friend likened him to the mountains of "Gobo." A week or two after the article was printed he received a letter from a professor of geology in a Western school asking him where the mountains of "Gobo" were.

Jim was feeling in jocular mood at the time and wrote a rather long reply saying that while the mountains of "Gobo" were in reality a chain of foothills in Terra del Fuego, still in comparison to the "Goboans" they were mountains as the "Goboans" were dwarfs.

He later received a letter thanking him for his prompt reply and then forgot all about it. Six months later he received by mail a pamphlet entitled "The Goboans and the Mountains of Gobo," written by the man whom six months before he had told where the mythical country of "Gobo" was. The pamphlet was apparently written in all seriousness.

I myself have been guilty of misleading, but it was, I think, justified. Some years ago I wrote some original matter on ants and spiders and sent it to an alleged scientific journal. A few days later it was returned to me with the thinly-veiled intimation that I was qualified for membership to the Ananias Club. I was annoyed; the matter was good and original, and could easily have been verified. I was satisfied that the scientific journal was not scientific, so I wrote a real lie about a peculiar orchid I had discovered in South America and sent sketches along with the following description to the same journal:

"One hot afternoon I sat down under some brushwood at the side of a large lagoon on the Rio de la Plata. Near at hand was a forest of dead thorn trees, which had actually been choked to death by orchids and climbing cacti. In front of me, and stretching over the water of the lagoon and about a foot above it, was a branch of one of these dead trees. Here and there clusters of common *planta del ayre* grew on it, and a network of green cacti twined round it. Among the orchids I noted one different from the rest, the leaves sharp, lancehead shaped, growing all around the root and radiating from it. From the center or axis of the plant hung a long, slender stem about ⅛ inch thick by ¼ inch wide, the lower end of which was in the water to a depth of about 4 inches. I at once went over to examine my discovery. Imagine my surprise, when I touched the plant, to see this center stem gradually contract and convulsively roll itself up in a spiral like a roll of tape. But more surprising was the object and construction of this stem. I found on closer examination and dissection that it was a long, slender, flat tube, the walls about 1/32 inch thick, cellular in construction, open at the outer end, and connected at the inner end to the roots by a series of hair-like tubes. By subsequent observation I found that when the plant was in want of water this tube would gradually unwind until it dipped into the water. Then it would slowly coil round and wind up, carrying with it the amount of water that that part of the tube which had been immersed contained, until when the final coil was taken the water was dumped, as it were, direct into the roots of the plant. The coil remained in this position until the plant required more water. Should the plant, however, be touched while the tube is extended, the orchid acts like the sensitive plant (*mimosa*) and the coiling is more rapid. I found many of these plants, all directly over the water, or over where the water had been. In the latter case it was almost pitiful to see how this tube would work its way over the ground in search of the water that was not."

In the letter sent at the same time I mentioned that I had "collected" for my friend, Prof. N. E. Brown, of Kew Gardens, London, England, the most famous botanical garden in the world. This was true. I did "collect" for Professor Brown, but not orchids. He was a postage-stamp crank, and every country I called at I brought him a full set of unused postage stamps for his collection.

The article was accepted and a check sent. This I kept. The article was copied all over the world. I got letters from many countries. Collectors wrote me asking for the exact locality so that they could send their agents to get samples. A farmer's daughter in Pennsylvania sent me 25 cents for one *orchid* plant.

All this happened about seven years ago, and the thing is not dead yet. Only a couple of months ago a friend in Utica, N. Y., sent me a clipping of it from a local paper. All this goes to show that a well told lie will stand almost as well as the truth.

I got together a collection of copies of the article in various languages and mailed them together with the check and a letter to the publisher of the alleged scientific journal. In the letter I told him the history of the case and what I thought of him. I got no reply, but I hope the lesson did him good.

New York. E. A. Dixie.

Some Tests Made with Blue Chip High Speed Steel

SPECIAL CORRESPONDENCE

A demonstration of some of the cutting qualities of Blue Chip high-speed steel was recently given in Worcester, Mass., by the Boston branch of Wheelock, Lovejoy & Co. The cutting tests were made on a Powell planer and a Lo-swing lathe. The material which was cut consisted of carbon steel with different carbon contents and cast iron, and some very interesting results were obtained.

The company also exhibited some of their steels, as well as tools which were made from these steels. One interesting thing that was shown was a piece of steel from which it is claimed 80,000,000 hack-saws are made annually in this country. Another was the roll of cold-rolled ribbon steel which is used for making band saws. This coil was over 300 feet long. A metal-cutting saw was also shown that was 28 inches in diameter and 3/16 inch thick. These saws are hardened by a special process, right to the center hole of the saw. A 26-inch saw of this kind is used by this company in their Boston warerooms for cutting up their high-speed steel, and this is run at a speed of about 95 feet per minute at the periphery of the saw.

The company also exhibited samples of its special brands of "Hy-ten-sil," "Non-sinkable" and "Nonshrinkable" steel. The last two named are steels that are used very largely by jewelry manufacture.

TESTS ON THE POWELL PLANER

The Powell accelerating high-speed planer was used for making the tests, owing to the fact that the speed can be changed while the tool is cutting. It has a variation of cutting speed of from 30 to 140 feet per minute; it accelerates from 30 to 60 feet and from 70 to 140 feet per minute, while it is in operation. The work is usually started at the lower speed, and after the tool has gone into the work about 1 inch the machine is then shifted to the high speed.

The first test conducted on this machine was on an open-hearth 0.25-per cent. carbon steel that was 3½x6 inches and 5 feet long. This was run at 30 feet per minute on slow speed, accelerating it to 70 feet per minute while cutting. At low speed with ½ inch depth of cut and 1/16 inch feed there was removed 3½ cubic inches of metal per minute, and the tool was in first-class condition at the end of six hours' constant running. When this speed was increased to 70 feet per minute on low speed and 140 feet per minute on accelerated speed while cutting, the cutting depth of the tool was reduced to ⅜ inch and the feed increased to 3/32 inch; 7½ cubic inches of metal was then removed per minute and the tool after a day's run did not show wear enough to warrant grinding. The tool used was 1x1½ inches, hardened at white heat, and cooled in an air blast.

The second test was on O. H. 0.75-per cent. carbon die blocks 8x9½x11 inches, two blocks being placed on the flap at the same time to facilitate the accelerating device on the planer. The depth of cut was ½ inch, with 1/16 inch feed running at 140 feet per minute. The Blue Chip steel ran all day without regrinding and looked at the end of the day as though it would run indefinitely. These chips were red hot at the end of the cut and the tool was at a low red heat.

The third test was on a block of the ordinary cast iron and the tool was run under all the different speeds of which the planer was capable. Cuts were taken from ⅝ to ¾ inch deep, with from 1/16 to 3/16 inch feed, and the speed was varied from 30 to 140 feet per minute. The stock removed averaged 10 pounds per minute. The tool was run for the whole week without regrinding. The amount of stock removed seemed so impossible that the chips removed were not only figured out, but they were actually weighed.

All of the tools used for the above tests were made from 1x1½-inch steel, heated to a white heat, and then cooled by an air blast.

TESTS MADE IN LO-SWING LATHE

Cast-iron bars 3½ inches in diameter and 4 feet long were used in the first three tests in the Lo-swing lathe.

In the first test a depth of cut of ¾ inch, feed 70 per inch, and a speed of 86 feet per minute was used. The tool was run for six hours and did not show the least wear, which might lead one to believe that on cast iron of this quality, not running in blow holes or sand streaks, it would last altogether too long from the steelmakers' point of view.

The second test was removing a ¼-inch depth of cut, 12 feed, at 130 feet per minute. The chips fell off red hot, but this made no perceivable difference on the point of the tool, which was ground with 15 degrees of clearance. This is a remarkable result and it is doubtful if the performance could be equaled if there was any difference in the quality of the cast iron. The tool was run at this rate all day. A speed of 150 feet per minute was next tried at the same feed, and ⅛ inch of metal was removed after the first cut had been taken off the bar. This made the travel of the carriage 28 inches per minute, and the tool ran about 10 minutes without any apparent impairment of the cutting edge.

The third test was on O. H. 0.25-carbon bar steel, and the tool stood up under all the different conditions up to the capacity of the power behind the machine. When run from ⅛ inch depth of cut, 12 feed, and 110 revolutions per minute to ½ inch depth of cut, 20 feed and 50 revolutions per minute, the chips came off of the machine red hot and sparks flew in all directions. The point of the tool was heated to a low red and this made absolutely no impairment on the keen cutting edge. The tool used was ¾-inch square. The most remarkable point of this test was the fact that although the friction of the cut created an enormous heat, there was not the least tendency of the temper in the tool, drawing sufficiently to break it down, although it was red hot.

The fourth test was made on O. H. 0.55-carbon steel, that was not as well annealed as a test of this kind should warrant. The depth of cut was ⅜ inch, with 50 feed, running at 50 feet per minute. Spiral chips were made during the day's run from 4 to 6 inches in diameter and 20 inches long. When the tool was taken out after a six hours' run there was a piece of metal ⅛ inch high and 1/16 inch thick welded on the hot cutting edge of the tool, but the keen cutting edge still remained. The cutting side of the chips, taken off, were so bright that they had a mirror-like appearance.

The fifth and last test during this run was made on Sterling 0.90- to 1-per cent. carbon-tool steel, single annealed. This was run at the same feed and the same speed as the above tests, but the heat generated from the friction was not as great as on the O. H. steel, and the tools did not become as hot when ground at the same angle of clearance. The above steels were also tried at from 75 to 185 revolutions per minute, with feeds varying from 50 to 15 revolutions per inch, and cuts varying in depth according to the capacity of the machine. The results on these were in proportion to the feeds and speeds used.

On chrome-nickel steel, as tested for automobile work, which was run at a speed of 40 feet per minute, with ¼ inch depth of cut and 15 feed; the tool was in A-1 condition after 15 hours of constant running.

The tools used on the above tests in the Lo-swing lathe were made from ¾-inch square, Blue Chip, high-speed steel, which was hardened at a white heat, and cooled in an air blast. In many of these tests the oil, squirted on the surface of the material cut, was heated so intensely that the flash point was reached, and when lighted a flame several inches in hight would follow the serpentine-like chips.

In hardening cutters with delicate cutting edges which must remain true and not be distorted this company uses the barium-chloride process for hardening, but only in rare instances can they heat the cutters in the barium chloride to over 2100 degrees Fahrenheit without the metal pitting. They are, however, constantly working on this proposition and may in the future be able to reach higher heats without pitting the steel.

The Tool Steel Sensation

When a few weeks ago Professor Arnold startled an audience by announcing the advent within a year of a tool steel that would do from three to four times as much work as even the best of its predecessors, he told either too much or too little. The wiser course would have been to have said nothing at all, but if Professor Arnold was unwilling or unable to adopt a course for which every steel maker in Sheffield would have praised him, he should have gone farther and laid the whole facts of the case before his hearers.

The first effect of Professor Arnold's prophecy was to give the impression that one firm only out of all those in Sheffield made the new steel, and that its invention was in the nature of a discovery. We do not say that Professor Arnold is responsible for this view, but that that was the outcome of his statement. Now, as a matter of fact, nothing could be farther from the truth. Experiments are continually in progress in all the best works, and we can assert with confidence that some half dozen other firms or more have known for many months that they could, when the time came, produce a steel many times more durable than the best now in general use. We may go even farther, and say that we have convinced ourselves that there are now on the market many steels which are quite capable of doing from three to four times as much as is generally expected of them, and we have one particular brand in mind which has been sold for the last two years or so, and although of comparatively low price, can beat, and has beaten, in our own tests tools made by the latest method. There is then absolutely nothing in the nature of a revolution in the production of these high-duty steels. They are produced by a natural process of development from what has gone before, and though vanadium enters into their composition, we need not tell our readers that that element is no new ingredient in tool steels.

The best makers, it must be remembered, never cease experimenting, and they keep on continually improving the steel they send out. But they do not continually change the brand or the name of the steel any more than a maker of a lathe or a dynamo gives a new name to it every time he effects an improvement in the design. Many of the steels now on the market are called by the same names that they have been called by since they were made; but, as a matter of fact, month by month improvement has been made in them, and many of them are far more durable than their prototypes. We have before us records of tests made with a variety of steels months ago which are as good as any prophesied by Professor Arnold, and we have also results that dwarf his into insignificance. The fact is that the maker knows enough now of the mystery of high-speed steels to give the purchaser anything he cares to pay for. It is no secret that the special steels sell for about half a crown a pound—many bars have been sold at that price—whereas the ordinary high-speed steels can be purchased for about 18 pence. For very special steels even 3 shillings 6 pence per pound or more may be asked. There are, of course, jobs where too high a price could not be paid for the tool, where any tool that would cut would be worth its money, but, taken on the whole, the average manufacturer is not prepared to pay half a crown a pound for his steel, simply because it is not worth his while, and we may take it that for years to come the ordinary high-speed steels, with such improvements as the makers are always effecting without augmentation of the price, will hold the field for general work against very expensive special brands. But anyone who needs special steels can have them by paying for them.—*The Engineer*, London.

Shop Work in Technical Education

By Con Wise

Among the things that are usually done wrong is technical educating. This has been said and denied so often that it may seem that the ground has been entirely gone over. Nevertheless, I believe that there is one phase of this question that has not been looked at from every possible angle; that is the relation between shop instruction and school-room instruction. This seems, in the minds of many, to be a question of the relation between the practical and the theoretical. I am not, however, inclined to admit any discrepancy between correct practice and correct theory, though I am aware that practice "as she is practiced" does not entirely agree with the theory evolved by both theorists and so-called practical men. As I have said before, the latter are the worst theorists possible. The question in my opinion is more between practice as found in money-making shops and practice as found in school shops.

I have watched many students through school and into work and I have begun to believe that for the average young man it would be a blessing that he should be thrown out once or twice during his course for a year at a time, and compelled to earn his living in a shop. To say to a boy that he must leave high school and go into a shop and learn a trade before he can go to a technical school is really to take away his best chance of success in the latter, for such schools, as organized, are simply places where the passing of examinations is the principal part of the curriculum. The boy who stays away from the schools three or four years gets stale beyond recovery in this necessary art.

But a boy who goes to school for, say, a year and a half, runs out of funds, lays off a year and works in a machine shop, returns to the school with a measure of experience and a knowledge that education is worth something; for it is a rare thing to find a shop which does not have at least some one man of education and power whose example is sufficient to send the boy back with renewed interest in his studies and a new point of view from which to attack them. He will also bring into his school-shop work either an ability which will enable him to secure release from the work, or else with a realization that there is more than one way to do most things and a desire to find out the school's way that he may take the best and make it his own.

This repeated once more before the end of his course, say, between the third and fourth years, will bring out a boy who has had a six-year course of study, two years of experience, two years' pay, and a book knowledge gained when quite a little more mature than many of his friends. He is two years nearer that maturity which all employers in self-defense demand before giving a young man a responsible job; he has two years less to forget his technical knowledge before he is allowed to use it. When we consider that nine-tenths of the disgruntled technical graduates are about two years out of their schools, we see that if more students followed the plan outlined there would be less disappointment.

I remember one young man with whom I was thrown in contact a few years ago. He was a graduate of a prominent engineering school and he was drawing something under $10 a week, keeping tabs on costs in the office of one of our tariff-fattened trusts. Every mealtime he regaled us with his knocking of the school from which he came, in which he was aided by a graduate of a college who was getting almost $11 per in the same office in a superior position. This enabled him to tell his friend of the advantages of a college education over a technical one. One day a letter came which turned the first young man into a loyal alumnus in less time than you could say James Robinson, or words to that effect. It was simply a letter from another concern offering him $2000 a year, resulting from a recommendation sent by one of his professors. These people would not have hired him two years before at any price. They knew of him, they sized him up as being capable but boyish and preferred to leave it to someone else to take the "boy" out of him.

The course of a boy through school is too much like a bicyclist picking his way over a road strewn with stones. He covers his distance successfully but at the end he does not know whether he went past a swamp or Niagara falls. I believe it is worth while to stop off occasionally and find out.

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Metric Tradition in the Making

We have already referred to the report of a committee of the American Society of Civil Engineers, advocating compulsory laws for the adoption of the metric system. This report is nothing but an expression of the opinion of the two men who signed it but, fairly treading on its heels, the public is already being led to believe that the report is an action of the society. In a recent number of the *Electrical World* we find a communication from M. C. E. Guillaume, of the International Bureau of Weights and Measures, Sevres, France, which opens with the following words:

"The recent important action taken by the American Society of Civil Engineers in favor of metric reform has been received with much satisfaction by all in Europe who know the advantages that the metric reform has there brought about."

The only action of the society in this matter was taken at its January meeting, and, according to the official report of that meeting, it was as follows:

"It was moved and seconded that the committee be discharged with thanks and that the report be printed," and on being put to a vote the motion was carried.

Nothing has been said, or done to excuse the statement that the Society has taken any action whatever "in favor of metric reform," and we are surprised that our contemporary, which has as good means as we for knowing the facts, should allow the statement to appear in its columns over the signature of a contributor and without correction.

Uncontradicted in the place of its origin, this statement may now be expected to reappear in metric essays with unfailing regularity, and the Society of Civil Engineers will soon be generally regarded as having endorsed compulsory laws for the adoption of the system.

Let no one imagine that the matter will stop here or in this country. M. Guillaume is the brains of the International Bureau of Weights and Measures, which is supported by the joint action of numerous governments, of which ours is one. In an official sense he represents these governments and his words carry corresponding weight. His bureau is the headquarters of the world for standards of measurement and for information relative thereto, as it is the world's center of the metric propaganda. From it this statement will be spread to every quarter.

In this we see an example of the origin of the mass of myth and tradition of which the metric case is made up. An opinion, or even a false statement like this, once put in print, goes from pen to pen and from mouth to mouth without being questioned, and, with the lapse of time, a case which is composed chiefly of misinformation is thus gradually built up.

The metric controversy is essentially a contest of facts with this mass of misinformation, and the only doubtful point is, which shall prevail?

The report of the committee of the Society of Civil Engineers is in fact, chiefly made up of a re-statement of fables and fictions which an investigation of the facts has demolished. This investigation the committee ignores, and thus places before the Society a report which it could not fail to repudiate did its members know the facts.

The Compulsory Working of Patents

Among the surprises of the new tariff bill which is now before the House of Representatives is a rider which has no relation whatever to the bill as a whole, and by which it is provided that patents shall be granted to foreigners by this country only under the same conditions as those granted to American applicants for patents by the country from which the foreigner comes.

The means by which this matter has been taken out of the hands of the Committee on Patents and placed in the hands of the Committee on Ways and Means are unknown to us, but the motive is apparently the quick passage of the measure in order to meet the widespread demand for it. We cannot but regard it as unfortunate, because, as a subsidiary feature of the tariff bill, it will naturally receive little or no discussion and probably be passed as it stands.

This measure was one of those discussed a year ago before the House Committee on Patents, and while it was generally recognized as, in principle, the most appropriate measure suggested, very serious objections to it were pointed out. These were discussed on page 22, Part 2, of our last year's volume, wherein we repeated the substance of some of the testimony given at the hearings of the Committee on Patents in which it was pointed out that the measure would require the issuing by our patent office of 116 different kinds of patents for different terms and upon different conditions, that it would require the interpretation of the same number of different patent laws, and that it would throw upon the patent office an unworkable volume of business.

As we have said before, we have as full sympathy with the idea behind this measure as anyone, but the occasion is plainly one for extended discussion and careful action which it now has scant probability of receiving.

One of the strongest arguments made before the House Committee on Patents a year ago in opposition to the measure was by the Commissioner of Patents on whose office the burden of the execution of the act must fall. It is too obvious to need discussion that the opinion of the Commissioner should not be ignored and

that a measure which is surrounded with such complexities as this should not be passed in the manner in which this seems likely to pass.

The hearings before the Committee on Patents last year were among the most instructive that we have ever seen. There was scarcely a witness before the committee who did not approve of the principle of the various measures proposed, but there was scarcely one who did not foresee far greater injury than benefit to American inventors and manufacturers in the operation of any of the measures then suggested, and there was none which received fuller discussion than the one now incorporated in the tariff bill.

Erratum

On page 63, at the bottom of the second column, the last term of the equation should read $(2\,d\cos.\,\theta)$, not $(2\,D\cos.\,\theta)$ as printed.

New Publications

MORRISON'S SPRING TABLES. By Egbert R. Morrison, 84 6x9-inch pages. Morrison & Martin, Sharon, Penn. Price, $2.

This work naturally divides into four sections—formulas, mathematical tables, tables for helical springs and tables for elliptical springs. The formulas cover both helical and elliptical springs and are worked out with a uniform notation. The mathematical tables are meager, consisting of the decimal equivalent for fractional parts of π where the denominators range from 1 to 24 inclusive. The fifth powers of fractions are given, ranging from 1/16 to 2 inclusive, the increment of increase being 1/16. Cubes of fractions are given for the range 1/16 to 11¼ inclusive, the increment of increase being 1/16. The tables for helical springs are divided into two sections, classed as light and heavy. The properties of the light springs are arranged for graduated values of the ratio, mean diameter of coil to diameter of wire. All springs made from wire less than 1/16 inch in diameter are classed as light, all others are classed as heavy. The properties of heavy springs are arranged according to the size of wire or bar. The light spring tables cover a ratio range from 3 to 9 inclusive. The increment of increase is 1/16. The tables for heavy helical springs are arranged for wire or bar diameters from 1/16 inch to 1½ inches inclusive, varying by 1/16 inch. These tables are all prepared for a circular cross-section. Factors are given whereby the quantities in the tables may be used for wire or bar of rectangular or elliptical section. The elliptical spring tables are also worked out for light and heavy springs. Springs made from plates less than 1/16 inch thick are classed as light; the others as heavy. These tables are not as extensive as those for helical springs, as they cover only 8 pages of the book.

STEAM PLANT ENGINEERING. By Prof. G. F. Gebhardt. 816 6x9-inch pages; 451 illustrations; indexed. John Wiley & Sons, New York City. Price, $6.

This book is a presentation, in concrete form, of the substance of the lectures delivered to his classes by the author, who is professor of mechanical engineering at the Armour Institute of Technology. Designed primarily as a textbook for engineering students, it is expected to be also of use to practicing engineers. Such a book naturally begins with the definitions of the terminology of its subject.

Chapter II treats of Fuels and Combustion, classifying and defining the fuels available, giving their reactions in combustion with the temperature produced, air required, etc., with tables of the heat carried away at different uptake temperatures, losses due to incomplete combustion, etc. The influence of size of coal on boiler capacity and efficiency is illustrated by a diagram. Several types of burner for pulverized fuel and oil are illustrated, but none for gas. The third chapter, devoted to Boilers, illustrates and describes the usual types in common use, explains the unit of evaporation, heating surface, boiler and furnace efficiency, etc.

Chapter IV treats of Smoke Prevention, Furnaces and Stokers, and in Chapter V the available information upon Superheat is grouped into the most convenient form that we have yet seen it for the practical man. Coal and Ash Handling Apparatus are then taken up. The succeeding two chapters, upon Chimneys and Mechanical Draft, contain that of which the practicing engineer is most likely to have need presented in a form available for ready use.

Steam Engines and Steam Turbines are then taken up. It is the author's opinion that notwithstanding the encroachments of the turbine and the gas engines, "the reciprocating steam engine will hold its own for years to come." The engine chapter is devoted to a general consideration of the effects of various disturbing causes upon the ideal engine, the value of condensing, compounding, reheating, jacketing performances under test, etc., without any attempt to describe existing types. That on the Turbine, however, consists in large part of descriptions of the forms most used, although much general information on cost, effects of pressure, vacuum, superheat, etc., is included. One of the longest chapters in the book is devoted to Pipes and Fittings. Lubricants and Lubrication, Furnace and Economics, Cost of Power, Testing and Measuring Apparatus, Typical Specifications and descriptions of A Typical Central Station and A Typical Isolated Plant complete the body of the work, a General Bibliography of the subject, the A. S. M. E. codes of Rules for Conducting Boiler and Engine Tests being introduced as appendices.

A commendable feature of the work is the placing after each section of a list of the sources of information upon the subject of which it treats. The book is made in the Wiley usual excellent style and the illustrations were evidently "made to order." The treatment is such as to make the book serviceable for the man of limited mathematical attainments. It is a book that can be studied to advantage and that having been studied will be much used for reference.

Personals*

E. E. Brosius, of Alliance, Ohio, has become associated with Pawling & Harnischfeger, Milwaukee, Wis., as sales engineer.

Walter B. Snow, publicity engineer, Boston, Mass., has been elected a member of the corporation of the Massachusetts Institute of Technology.

John E. Lord, until recently with the Hooven-Owens-Rentschler Company, has become assistant manager of the Sight Feed Pump Company, Milwaukee, Wis.

S. B. Sheldon, formerly general superintendent of the Lackawanna Steel Company, has recently associated himself with the Bethlehem Steel Company in the capacity of general superintendent of the saucer department.

George H. Baush, formerly general manager of Hill & Clarke Company's Philadelphia branch, has recently been made general sales manager of the Fay Machine Tool Company, with headquarters at Philadelphia, Penn.

L. G. Nilson, chief engineer of Strang Gas Electric Car Company, New York City, has been elected president of Nilson-Miller Company, of 1300 Hudson street, Hoboken, N. J. He will continue as consulting engineer for the Strang company.

Frank H. Neely, who has been connected with the operative department of the Westinghouse Electric and Manufacturing Company, and is a regular contributor to our columns, has recently established himself in Atlanta, Ga., as an industrial engineer.

Reuben Hill, general superintendent of the Tiffany Studios factory, previous to which employment he was mechanical superintendent with the Yale & Towne Manufacturing Company, has recently entered the employ of the Bristol Engineering Corporation as factory manager.

J. W. Bray, for the past year in charge of the Philadelphia office of the Bullard Machine Tool Company, has returned to the Bridgeport headquarters and will look after the interests of his company in the New England territory. R. H. Snider succeeds Mr. Bray in the Philadelphia office.

*Items for this column are solicited.

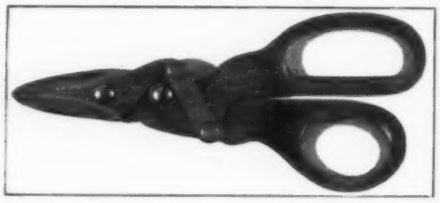
New Tools and Machine Shop Appliances

Showing New Ideas in Machine Shop Equipment That Make it Possible To Do Better Work at a Reduced Cost

THE LATEST INFORMATION

Compound Lever Snips

The half-tone shows a pair of snips designed for small work. They are made of sheet metal and by the use of compound levers and a link the power necessary for cutting is no greater at the extreme ends of the blades than it is close to where they are pivoted. They will cut 26-gage soft steel and 20-gage soft brass or copper.



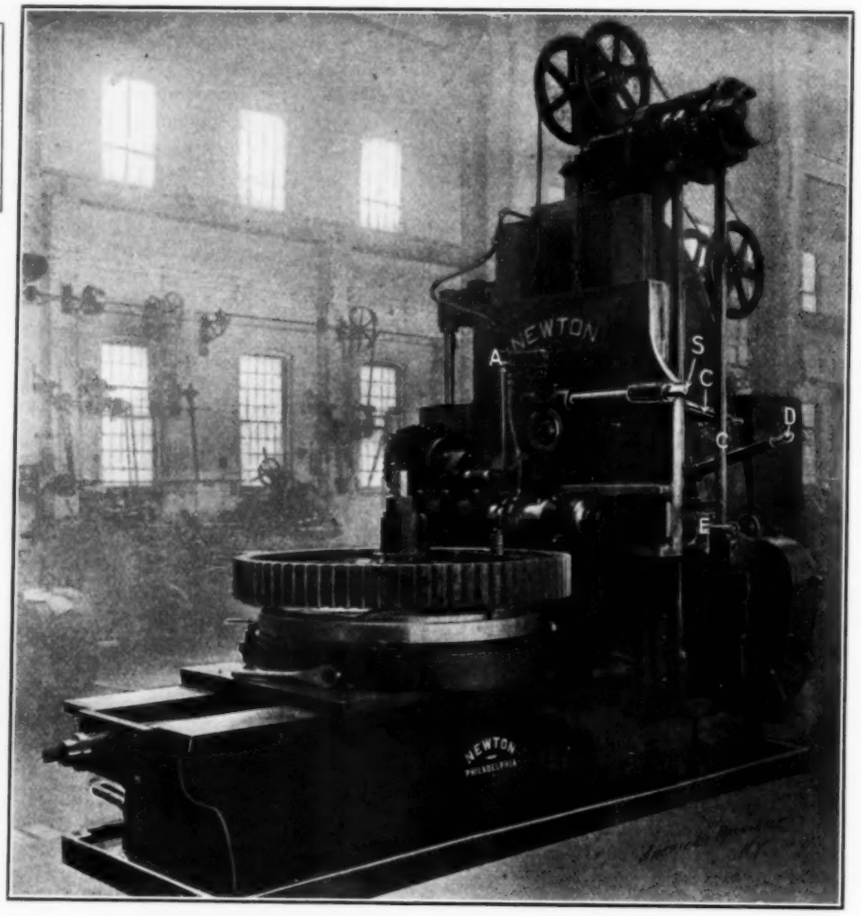
COMPOUND LEVER SNIPS

The blades are so formed that circles or square corners can be cut. The snips are 7 inches long and weigh 5 ounces. They are made by the Detroit Shear Company, Detroit, Mich.

A Large Gear Cutter

This is the latest spur-gear cutting machine of the Newton Machine Tool Works, Philadelphia, having a capacity of 84 inches and cutting at any one of nine rates of feed from ½ to 8 inches per minute. The spindle is 4 inches in diameter, has a No. 6 Morse taper and is mounted on an auxiliary slide for convenience in setting the cutter central. The cutter is driven by coarse pitch gears and a hardened worm running in a bronze wheel, both in oil. Power is furnished by a 15 to 20 horsepower, according to requirements, a 2 to 1 motor being used. The cutter arbor is driven by a broad-faced key and is held in place by a through bolt, the other end being supported in an outboard bearing.

The engagement of a clutch on the vertical driving shaft *A*, gives motion to the entire indexing mechanism through a friction plate. The index plate has a slot with a hardened-steel face, which engages the stop automatically at every one, two or three revolutions as desired, allowing one, two or three teeth to be cut at once according to the number of cutters used. The fast traverse and feed motion clutch are engaged by a lever connected to the rod *B* which engages with an adjustable trip on the back of the saddle and releasing the clutch from the feed drive to be engaged in the fast traverse by a spring roller latch operating on the lever *C*. The engagement of the fast traverse, however, is prevented by a safety latch on the lever *D* until after the indexing has been completed when an eccentric plate mounted on the shaft *E* releases this latch, permitting the spring control lever *D* to engage the fast power return. The shaft *E* is connected to and controlled by the index plate which prevents any vertical feed until the indexing is completed. The lever *D* also is fitted with an auxiliary latch which can be engaged with the rod *B* to prevent the vertical feed being engaged through any number of revolutions of the table. This is a very desirable feature as many of the gears for which this machine was particularly designed are in two parts and it is necessary to rotate the blanks in order to find if the teeth are properly located in relation to the joints.



A LARGE SPUR-GEAR CUTTING MACHINE

The work table is 40 inches in diameter and has radial T-slots for clamping the work surrounded by a reservoir to catch the lubricant. The tables and saddles are so designed that the lubricant is carried directly through circular grooves in the table and saddle to the frame of the machine and returned to the supply tank from which lubricant is again returned by means of the cutters to the rotary pump. The dividing worm ring is made in two sections to allow for adjustments to compensate for wear. The driving worm is arranged with roller thrust bearings and is fitted in a bracket which can be disengaged by the eccentric lever *R*. The illustration shows the machine in operation on a gear having seventy-six 2-inch circular pitch teeth, two teeth being cut at one time at the rate of 5½ inches per minute, which is the width of the face of this gear. One roughing and one finishing cutter are used simultaneously so that the cut taken after each indexing amounts to one completed tooth. This machine was particularly designed for the rapid production of street-

railway motor gears, but has since been received favorably by the general manufacturing trade for its heavy class of gears. Some of these machines are used in cutting three pitch gears three teeth at one time, being, in this instance, arranged for triple indexing. It weighs about 20,000 pounds and will occupy a floor space about 10x12 feet over the oil pan on which it is mounted.

Improvement in Disk Grinder

The Ransom Manufacturing Company, Oshkosh, Wis., have improved their disk grinder by the addition of hardened-steel end thrust collars to the spindle. They are also using steel disks to support the sheet of abrasive. In addition to these they have adopted a new oiling device for their countershafts which holds sufficient oil to last several weeks. This oils the pulley while the machine is standing still.

A Precision Boring Tool

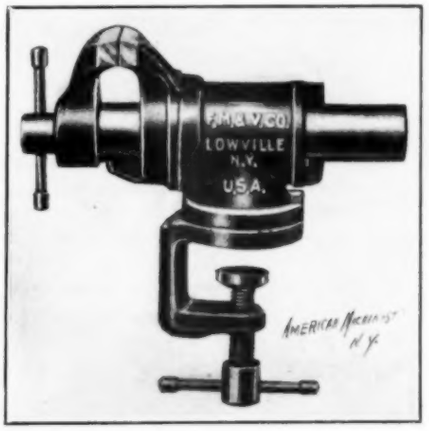
Users of small boring tools in jig making and in similar places will appreciate the tool shown herewith. It consists of a body which is held in a chuck or in any other manner, and a tool holder that can be adjusted across its face by the nurled knob at the end. This is graduated so as to read to thousandths, in this way allowing the operator to know just how much he is enlarging the hole at each setting.

A PRECISION BORING TOOL

It is carefully made, the wearing parts are carbonized and it is a substantial little tool with a capacity of 3 inches. It is made by the Precision Boring Tool Company, Detroit, Mich.

Small Double Swivel Vise

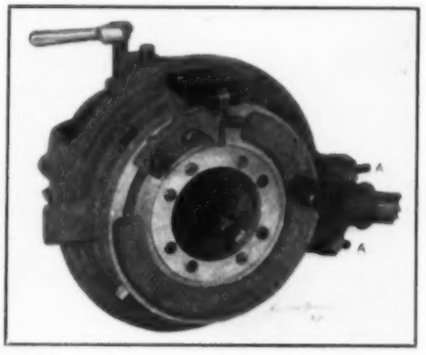
Although designed especially for automobile and motor-boat work, this vise should be found equally useful in many other cases, such as repair shops of all kinds or in the tool room where it is necessary to hold work at varying angles. It is so designed that gripping a piece of work in the jaws, locks both the swinging and swiveling of the vise, holding the work firmly at whatever angle it is held when the screw is tightened. It is of simple construction, the wearing surfaces are large, there are no levers nor pivots, and altogether it seems to be a very desirable little tool. It is made by the Fulton Machine and Vise Company, Lowville, N. Y.



A SMALL DOUBLE-SWIVEL VISE

Ratchet Driven Die Stocks

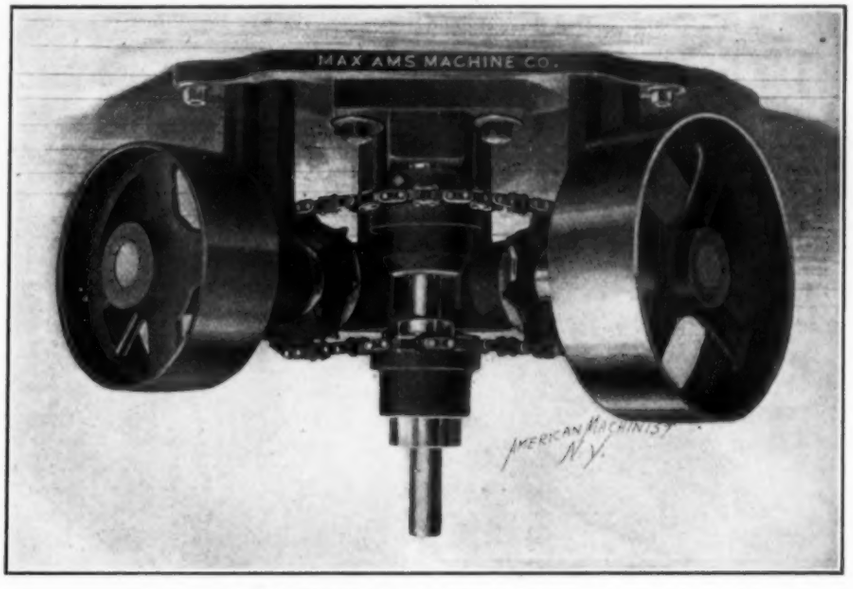
The Hart Manufacturing Company, Cleveland, O., whose geared die stocks were recently illustrated, has brought out a line of Buckeye die stocks in which the power is applied by a ratchet instead of gears. Instead of gears the ring carries two latches *A A* which engage, one at a time, for either right- or left-hand work. This enables the die stocks to be used in close places where it is impossible to get a complete revolution of the usual handle. In other ways it is similar to the geared heads and can also be used for cutting off pipe as was shown at the time.



A RATCHET-DRIVEN GEAR STOCK

A Novel Angle Drive

The driving of shafting at right angles is often a serious problem, the latest solution being that of the Max Ams Company, Mount Vernon, N. Y., and illustrated herewith. It consists of four sprocket wheels and a special chain, built with link openings in both directions. This is necessary to mesh with the idle sprockets on the short vertical shaft and at the



A NEW ANGLE SHAFT DRIVE

same time mesh with the driving and driven sprockets. It is a very simple device and is built to transmit various amounts of power.

Radial Drill

The half-tones illustrate a cone-driven radial drill built in 2½-, 3- and 3½-foot sizes by the Mueller Machine Tool Company, Cincinnati, O. These drills are built in addition to the regular line of standard drills manufactured by this concern and embody many of the features of that line of drills. The stationary column which is bolted to the base is of heavy section, and the arm is of pipe section clamped to the column by two handles shown in Fig. 1. The arm may be raised and lowered rapidly, and is controlled by

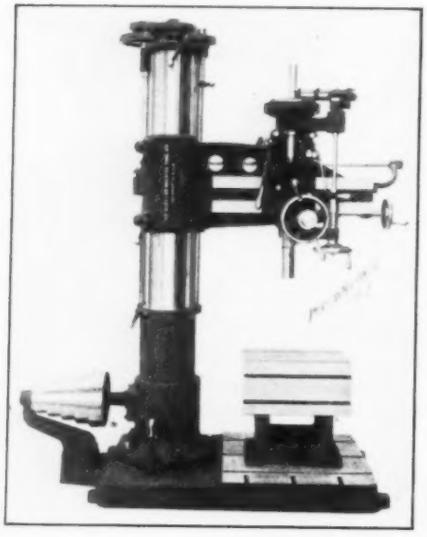


FIG. 1. RADIAL DRILL

a lever on the cap within easy reach of the operator. The head is traversed by means of a double-thread screw, and is equipped with a suitable locking device. Correct speeds for all kinds of drilling

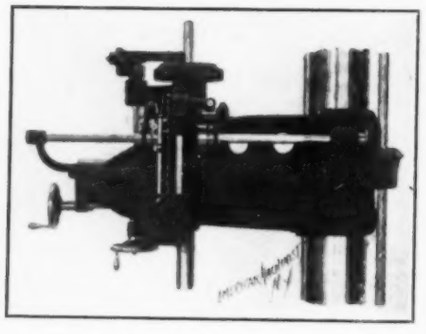


FIG. 2. BACK OF RADIAL ARM

are shown on a bronze plate attached to the arm enabling the operator to obtain the proper speed at a glance. There are 10 changes of speeds for the spindle and these may be varied while the drill is in motion. The spindle has quick advance and return, and is counterbalanced, as illustrated in Fig. 2, which shows the rear of the radial arm. A tapping attachment with which the machine is equipped is so arranged that an adjustable screw causes the tap to slip when it reaches the bottom of the hole. The starting, stopping and reversing lever is located on the head and directly in front of the operator. The automatic feed has four changes and can be operated as a positive or friction feed; the changes can be made while the drill is in operation. The machine is equipped with any form of table desired.

A New Pipe Wrench

This wrench has several new features that will appeal to users of such tools. It has no springs, no pivoting pin and the sliding jaw is supported by the frame clear over the pipe to be gripped. The nut is not let into the frame, but has a full bearing at the back of the frame. The thread is milled in the sliding jaw, which is guided both in the frame and a rib on the lever. Both the sliding jaw and the lever handle have hardened-steel jaws inserted which grip the pipe. In use the front edge of the frame bears against the pipe at all times so that raising the lever withdraws the teeth from the pipe, avoids locking and saves the teeth of the hardened jaws. It is very substantial in design, and seems to possess many points of value. It is being handled by George C. Winslow, Kalamazoo, Mich.

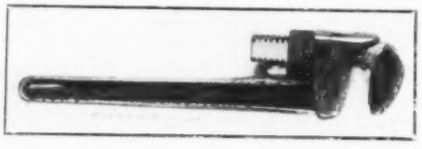


FIG. 1. A NEW PIPE WRENCH

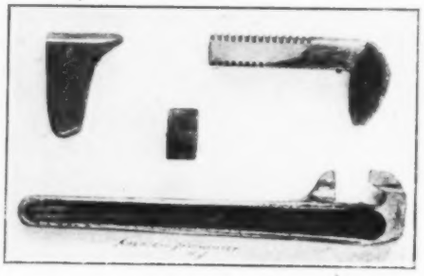


FIG. 2. PIPE WRENCH DISASSEMBLED

Two Large Valve Boring Machines

The making of large valves, both angle and gate, require special machines and those shown herewith have been designed especially for this purpose. The first is for gate valves, whose seats are at an angle to the stem and to bore and face both ends at once. The machine is built in three parts, the central or holding portion being bolted firmly to the base.

At each end, connected only by the hinge shown, is a boring head with independent gearing. These are moved on the base by the rack and pinion at the end of the bed, and when set at the proper angle are bolted in place.

The machine shown is belt driven, but they are also made to be driven direct by a motor when desired. The driving train is easily seen, which includes the main drive of the outer spindle, the independent drive of the inner or telescoping spindle and the feeds. These are shown in Fig. 2, the heads being fed into the work by the worm and wheel shown. When a facing arm is used the star feed pins are held in

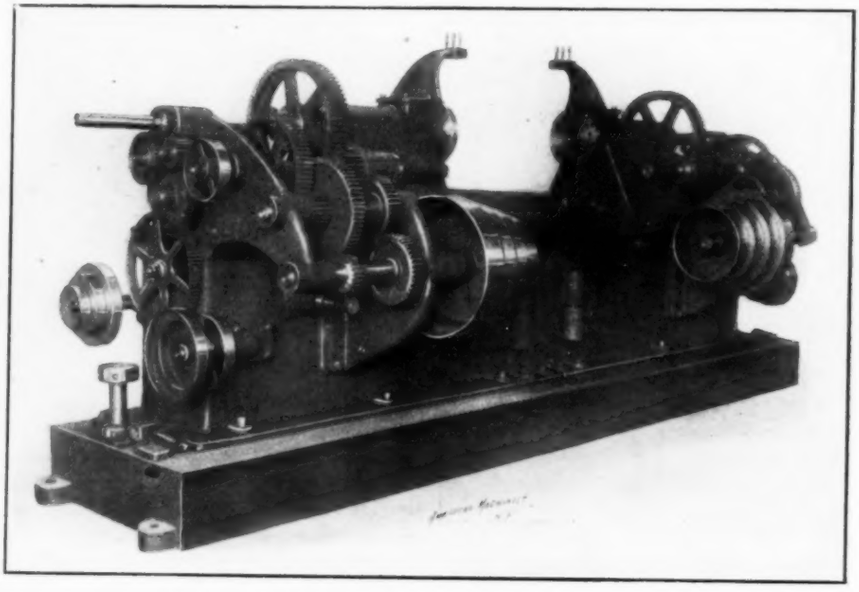


FIG. 1. A MACHINE FOR FACING GATE-VALVE SEATS

the over arms, using one or more as desired.

THREE-WAY FACING MACHINE

This is for large globe valves or pipe fittings and consists of a heavy bed, supporting a revolving work table and carrying three saddles. Each saddle or head has a horizontal movement and carries a facing head, as shown.

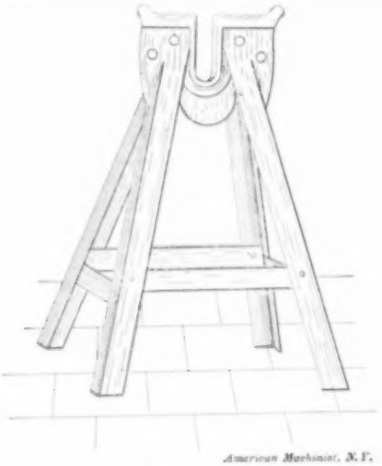
The revolving table is 32 inches in diameter, is graduated in degrees and has eight holes for index pin. This allows three surfaces to be machined at the same time. The spindles are all driven from one 4-step cone, through gearing of different ratios, giving six changes of speed, varying from 8 to 44 revolutions per minute. The feeds are four in number, from 4 to 32 per inch, and each facing head is provided with a patented feed which gives a continuous in or out movement. This is done by gearing from a shaft passing through the center of each spindle. Either the ratio or direction can be changed by conveniently located levers, and the tool block can be adjusted by the operator whether the spindle is stationary or in motion.

It will face to 28 inches in diameter, and can be set so that the facers are anywhere between 12 and 40 inches apart. The spindles can be brought within 17 inches of the center, or set 32 inches away, while the facer can be varied from 6 to 20 inches. From center of spindle to table is 15 inches. It weighs over 18,000 pounds.

These are all heavy, substantial machines, especially designed for the work they are to do, forming almost a class of machines by themselves, and are made by Beaman & Smith, Providence, R. I.

Steel Auto Axle Stool

The repair of automobiles, as well as their manufacture, has brought out many devices, one of the latest being the axle stool shown with this. It is light to handle, yet strong enough to support any car. The top is a steel casting, made with a gap to take the truss rod and still allow



STEEL AUTO AXLE STOOL

the weight to be carried by the axle itself. It is made in different hights, from 15 to 18 inches, and is 12 inches square at the base to insure stability. Although designed especially for automobile repair shops there are doubtless other places where it might be handy, especially as the sets of four are sold at a very reasonable price. It is the invention of Reinhold Betterman, Johnstown, Penn.

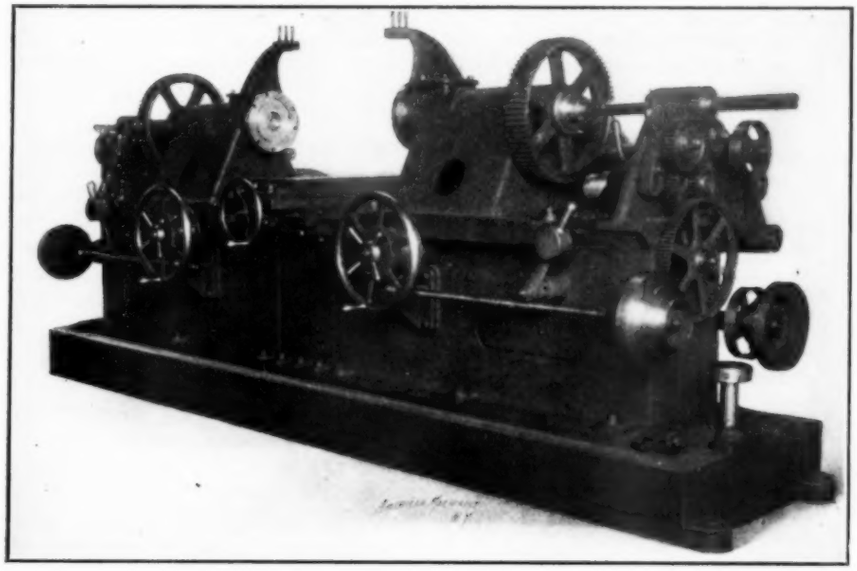


FIG. 2. THE OTHER SIDE, SHOWING THE FEEDS

"Marvel" Draw Cut Power Hack Saw

In this power hack-saw the pressure on the blade is due to an eccentric in connection with the compression spring at the front of the machine, pressure being brought to bear on the draw stroke and the saw being relieved on the return stroke. The tension on the spring is regulated by a hand nut seen at the end of the spring. The feed lever at the top carries a tension thumbscrew which is left engaged when sawing medium or light

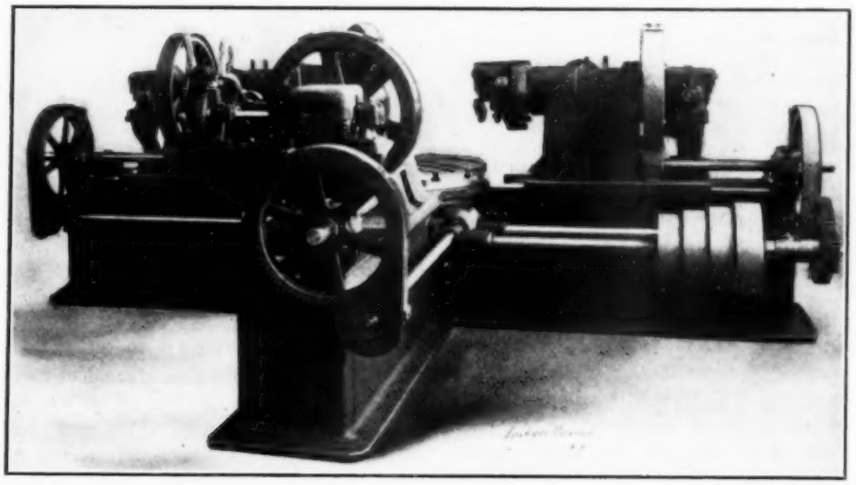
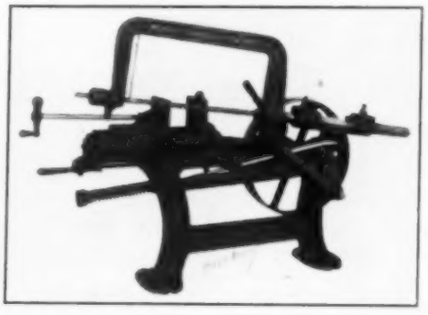


FIG. 3. THREE-WAY FACING MACHINE



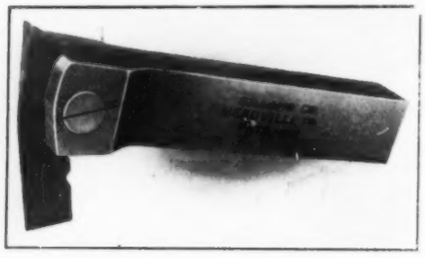
THE "MARVEL" DRAW-CUT HACK SAW

material. This lever raises or lowers the saw and may be used to hold it in any desired position when setting or measuring work. The vise swivels in both directions and may be set to enable work to be cut off at any angle required. The drive

shaft has bronze bearings. The two bearings for the saw frame can be taken up readily, and are provided with receptacles for oiled waste. The starting handle and automatic stop are conveniently located at the front of the machine. The stroke is adjustable from 4 to 6¾ inches. The capacity is 6x6 inches on the long stroke and 8x8 inches on the short stroke. The machine takes blades from 12 to 17 inches in length. It is made by the Armstrong-Blum Manufacturing Company, Chicago, Illinois.

Improved Tool Holders

The G. R. Lang Company, Meadville, Penn., have improved their tool holder so that it is now more convenient than ever. The binding bolt is flattened on one side and when turned to bring the screw slot in line with the "out" mark, this allows the tool to be slid up or down freely.



IMPROVED TOOL HOLDER

When turned to the "in" mark, the bolt body engages with one of the grooves in the back of the tool point and locks it securely in place.

Those who desire to forge their own tool points so as to use their own brand of steel will be supplied with die block so

IMPROVED TOOL HOLDER

as to make the points in their own shop. The threading-tool points can be made from bar stock, which comes glass-hard and needs no tempering.

According to a consular report, the Budapest news-telephone service, established many years ago, continues in successful operation. An annual subscription, $7.31, paid quarterly in advance, entitles the subscriber to two receivers and the full service of news, music, etc., the subscriber to pay the expenses of installation and removal, generally about $8.50.

A Variable Scale

By H. A. S. Howarth

A variable scale is one with which any odd-sized drawing or reproduction can be measured accurately by simply adjusting the scale to correspond to any known dimension and then measuring the others directly by means of the scale. Such a scale will be described, together with the particular case for which it was designed.

It became necessary to dimension completely a set of photographs, no two of which were to the same scale. The need of a variable or adjustable scale at once became evident; otherwise the task would have been tedious. The photographs were sorted, two being chosen which represented the greatest and the least reduction of size. The known dimension of one of these was carefully transferred to a drawing paper and laid off as AB in Fig. 1. This represented 4 feet 8 inches. The known dimension of the other was laid off as CD parallel to and symmetrically below AB at about the distance shown; CD represented 4 feet 10 inches.

The line AB was next extended to E so that AE would measure about 4 feet 10 inches in proportion to AB. The point F was then placed in the same proportion 1 foot from A. By connecting AC and ED and producing them a point of intersection G was found. The line FG was then drawn.

Suppose now a line HKL be drawn parallel to AE. Then it will measure 4 feet 10 inches if measured by the unit length HK. In just the same manner CM is 1 foot of the scale which measures CD as 4 feet 10 inches.

Having established the principle and the proportions, the diagram shown in Fig. 2 was then constructed making OP equal to AF and QR equal to CM. As many feet were then laid off on OPS as would serve to measure the greatest dimension

FIG. 3. THE FINISHED VARIABLE SCALE

on the photographs. The point G' was placed to correspond to the position of G in Fig. 1. The length OP was divided into 12 parts and 12 lines were drawn to G'. These represent the inch spaces while the lines $1G'$, $2G'$, $3G'$, etc., represent the foot spaces. This diagram was then reproduced on a piece of tracing cloth. This was cut off at WX and UV. It was then bent over to form a hollow cylinder and the edges WX and UV pasted together so that QT and OS remained parallel. When dry it was flattened and slipped over a strip of cardboard which had been previously prepared, as shown in Fig. 3.

By slipping the tracing cloth back and forth around the cardboard any length of scale can be brought to the working edge provided its unit foot is not less than QR

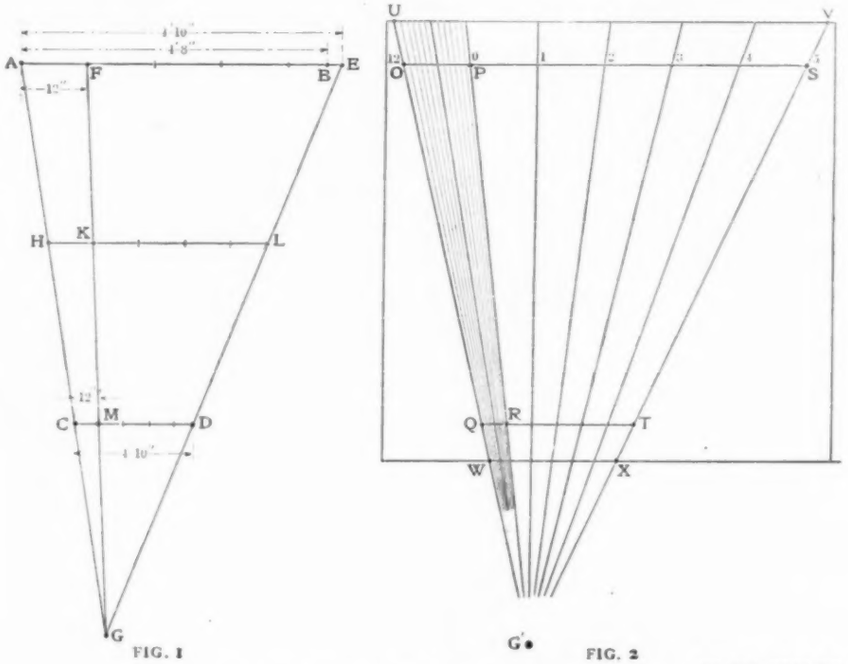


FIG. 1 FIG. 2

American Machinist, N.Y.

DIAGRAMS AND GRADUATIONS FOR A VARIABLE SCALE

or greater than *O P*. The ease with which the photographs in question were measured is at once evident. This variable scale has numerous applications besides the one for which it was designed. It may be used for laying off proportionate distances on lines of varying lengths, or for dividing lines into any number of equal or proportionate parts. When standard parts of machines have to be laid off repeatedly in different sizes a scale similar to the one described above can be constructed so that a set of dimensions for the size required may be slipped to the working edge of the scale and used.

Forthcoming Meetings

National Metal Trades Association, annual meeting, April 14-15, New York City, headquarters Hotel Astor.

American Society Mechanical Engineers, semi-annual meeting, Washington, D. C., May 4-7.

American Supply and Machinery Manufacturers Association, joint convention with Southern Supply and Machinery Manufacturers Association, Chattanooga, Tenn., May 5, 6, 7; headquarters, Hotel Patten.

National Supply and Machinery Dealers Association and American Supply and Machinery Manufacturers Association, joint convention, Pittsburg, Penn., May 12-13-14, headquarters Fort Pitt hotel.

The Foundry and Manufacturers Supply Association, convention, Cincinnati, Ohio, week of May 17.

American Foundrymen's Association convention, Cincinnati, Ohio, May 18-20, headquarters Hotel Sinton.

American Hardware Manufacturers Association, joint convention with Northern Hardware Jobbers Association, Pittsburg, Penn., June 9-11, headquarters Hotel Schenley.

Railway Master Mechanics Association, annual convention, June 16-18, Atlantic City, N. J.

Master Car Builders Association, annual convention, June 21-23, Atlantic City, N. J.

Business Items

The general offices of Edwin R. Kent & Co., Chicago, have been moved to 115 Adams street.

Charles A. Schieren Company has moved its Boston office to 641-643 Atlantic avenue (opposite South station).

The Wagner Electric Manufacturing Company announces the removal of its district office in Pittsburg to the Lewis block and the appointment of Ludwig Hommell as district manager.

The business in automatic spur gear-cutting machines heretofore conducted by the Cincinnati Shaper Company, has been transferred to the Cincinnati Gear Cutting Machine Company, Cincinnati, Ohio, which company in the future will manufacture and sell this line of machine tools.

A Eugene Michel, who, as manager of a technical advertising organization, has, for the past few years, been identified with the publicity of numerous large manufacturing concerns, has just opened new offices at 1572 Hudson Terminal buildings, New York. Mr. Michel will in the future confine his efforts as an advertising engineer to the promotion of steam specialties and apparatus, power transmission appliances and machine tools, and will limit his clientele to the number of firms to whose work he can give personal attention.

Business Opportunities

J. W. Mackemer & Co., Peoria, Ill., will erect a planing mill.

B. F. Avery & Sons Co., Louisville, Ky., will erect a new plow plant.

The Rutland Railroad is to build a new roundhouse in Bennington, Vt.

The Mitchell Motor Car Company, Racine, Wis., will build a $300,000 addition.

The Topeka (Kan.) Steam Boiler Works, recently burned, is to be rebuilt at once.

The United Wireless Telegraph Company, Seattle, Wash., is to erect a new factory.

It is said the Iowa Central Railroad will build auxiliary shops at Oskaloosa, Iowa.

The Jewel Motor Car Company, Massillon, Ohio, will build a two-story addition to plant.

The Illinois Traction Company will spend $100,000 for additions to shops at Decatur, Ill.

Carlos Gonzalez U., Carrera 296, Chillan, Chile, is inquiring for machinery for a furniture factory.

The Sight Feed Oil Pump Company, Milwaukee, Wis., is having plans prepared for new plant.

The Portland (Me.) Ship Building Company is erecting a new building to be used as a machine and engine shop.

The General Electric Company, of Schenectady, N. Y., is to build a $100,000 addition to its plant at Toledo, Ohio.

Roku Roku Shoten, 3 Shinsakanacho, Tokyo, Japan, are inquiring for pulley turning lathes and screw thread presses.

The Ruston (La.) Foundry and Machine Company is to install additional machinery for manufacturing car wheels, etc.

Plans have been completed for two additions to the cabinet-making plant of the Victor Talking Machine Company, Camden, N. J.

The Guilford Manufacturing Company, Buffalo, N. Y., recently incorporated to erect plant for the manufacture of woolen and silk yarns, etc.

Fire destroyed the shipping and storage departments of the Standard Foundry Company, Cleveland, O., causing a loss of about $10,000.

The Harvey Hubbell Company, Bridgeport, Conn., manufacturing tapping and riveting machines, etc., will build a new five-story factory.

The Russell, Burdsall & Ward Bolt Co. is to erect a $40,000 addition to plant in Rock Falls, Ill. The main plant is located at Porchester, N. Y.

The Barrett Manufacturing Company, Chicago, Ill., is said to be planning the erection of a new plant. The company manufactures roofing materials.

The E. L. Watrous Manufacturing Company, Des Moines, Iowa, making hardware specialties, will erect a two-story addition and install new machinery.

The Kinnear Manufacturing Company, Columbus, Ohio, manufacturing steel doors and shutters, is having plans prepared for a large addition to plant.

It is reported that the New York Central & Hudson River Railroad Company is planning to rebuild car repair shops at Lyons, N. Y., which were recently burned.

Mappin & Webb, Ltd., Royal Works, Sheffield, England, silversmiths and cutlers, are in the market for machine for stamping monograms on spoons, forks, etc.

The Tabor (N. C.) Lumber and Crate Company, recently incorporated, will establish plant to manufacture crates, door, blinds, etc. F. A. Tucker and others, incorporators.

The Luzerne (Penn.) Manufacturing Company, founders, machinists and blacksmiths, are building a new foundry and machine shop. The old foundry was burned some time ago.

The foundry building at the plant of the Central Foundry Company, at Anniston, Ala., was destroyed by fire, causing a loss of about $60,000. C. R. Schmidt, with headquarters at New York, is vice-president and general manager.

The William H. Page Boiler Company, which moved the larger part of its plant from Norwich, Conn., to Meadville, Penn., after its plant burned, has decided to erect at Norwich a storehouse and machine shop to set up boilers shipped in parts from Meadville.

The Isthmian Canal Commission, Washington, D. C., will receive bids up to 10:30 a.m., April 5, for pipe and fittings, valves, cocks, grease and oil cups, lubricators, oil pumps, steam whistles, gage glasses, gages, engine indicators, ammeter, tachometer, planimeter, etc., as per Circular No. 498.

The Toledo (Ohio) Machine and Tool Company has let contract for a three-story addition to main shop. This is to be equipped with large tools, specifications calling for 60-inch lathes, 8-foot boring mills and gear cutters, 30-inch slotters, etc. Additional cranes will also be installed.

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open bids as follows: April 6—Induction motors (schedule 1058), arc lamps (schedule 1052), twist drills, files, screws (schedule 1066), scaling gear machinery (schedule 1041), ash-hoisting engines (schedule 1043), engine lathes (schedule 1039), expanding mandrels (schedule 1066), tool grinding and shaping machine (schedule 1040), crank shapers (schedule 1039), turret turning gear (schedule 1042); April 13—Drilling machine (schedule 1062), ice machines (schedule 1061), motors (schedule 1037); April 20—Turbo-generating sets (schedule 1048), lathes (schedule 1038), drill presses (schedule 1038).

Want Advertisements

Rate 25 cents per line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Miscellaneous Wants

Caliper list free. E. G. Smith, Columbia, Penn.

We buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Wanted—Bench lathe with grinder countershaft, A-1 condition. Box 818, Bristol, Conn.

Hand power bending tools, labor-saving, money-making. Estep & Dolan, Sandwich, Ill.

Wanted—Machinery to manufacture on contract. Hydrostatic Machinery Co., Rochester, N. Y.

Light, fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Machines designed; automatic, special. Practical working drawings. C. W. Pitman, 3519 Frankford Ave., Philadelphia, Pa.

Special machinery accurately built. Screw machine or turret lathe work solicited. Robert J. Emory & Co., Newark, N. J.

Light and medium weight machinery and duplicate parts built to order; tools, jigs, etc. MacCordy Mfg. Co., Amsterdam, N. Y.

A small but well equipped machine shop in Connecticut desires to add other devices to its present line. Box 28, AMER. MACH.

Wanted—Punch press and jig work; good facilities for manufacturing of light articles. Models, dies, tools, etc., made. Joseph Pollak, 215 Sydney St., Dorchester-Boston.

Lathe, planer and milling machine work, gear cutting, etc., solicited; or machines built complete, by a shop making high-grade machine tools. Estimates furnished. J. F. Bowman, Box 4, Station B, Cincinnati, Ohio.

A large English firm of machine-tool importers having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMERICAN MACHNIIST.

We design and build, or build from drawings sent us, all kinds of light machinery, from 4000 pounds down to clocks, including sewing machines and typewriters; also jig fixtures and model work. Matson Machine Co., Bethel, Vermont.

In order to settle an estate an attractive opportunity is open to a party with $150,000.00, competent to fill responsible position either in the sales or manufacturing department, to purchase an interest in a well and favorably known, profitable machinery manufacturing plant located in Pennsylvania, with an office and established trade in New York City. Address "Executors," care of AMERICAN MACH.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

CANADA

Mechanical draftsman, 14 years' experience, five of which were spent in the shop, wishes a position. Experience principally on engine and boiler work, stationary and marine. Good recommendations. Box 997, AMER. MACHINIST.

CONNECTICUT

Wanted as superintendent, a man with rare executive ability, A-1 character, first-class mechanic, capable of taking charge of a large plant. Box 22, AMERICAN MACHINIST.

ILLINOIS

A capable and experienced designer of special machinery and tools for manufacturing purposes wants a responsible western position. Box 45, AMERICAN MACHINIST.

INDIANA

Situation wanted as superintendent or general foreman by aggressive and successful manager of men. Interchangeable work. No cure, no pay. Box 8, AMERICAN MACHINIST.

MASSACHUSETTS

Wanted—A position as chief designing draftsman with company manufacturing steam and water valves. Address Box 24, AMERICAN MACHINIST.

Production superintendent who can reduce costs and increase production in the manufacture of valves, fittings and pipe for power plants. Box 991, AMERICAN MACHINIST.

I would like to hear from manufacturer who wants manager that is a first class toolmaker, superintendent and organizer. Can make prices cut costs and has had six years' selling and sales manager in United States and Europe. Well posted on best tools and production. I will take small salary and share of saving over present costs. Shall expect good salary if results are shown. Thirty-six years old and not afraid of work. Address "Cleveland," AMERICAN MACHINIST.

NEW JERSEY

Mechanical draftsman wishes position. Box 25, AMERICAN MACHINIST.

Contract shop, automobile machinist and draftsman, married, 26 years old, several years foreman, desires position. Box 43, AMERICAN MACHINIST.

NEW YORK

Wanted—Position as draftsman, detailer or tracer. Can furnish best of reference. Box 44, AMERICAN MACHINIST.

Mechanical engineer, well up in design, shop supervision and business methods, experienced technical school teacher, wants position in metropolitan district. Box 20, AMER. MACH.

Draftsman, technical graduate, eight years' experience on automatic and special machines. Accurate, quick and neat. Best references. Address Box 29, AMERICAN MACHINIST.

Progressive, up-to-date machine shop superintendent—very successful organizer and cost reducer—wants to change. Location immaterial. Address Box 32, care AMER. MACH.

Mechanical Drawing—A competent toolmaker, age 24, has experience on all around toolmaking, machinery; has some experience on drawing and designing tools and devices. Now employed; wishes to make a change, with opportunity to continue mechanical designing. References. Box 33, AMERICAN MACHINIST.

WISCONSIN

Experienced designer, age 29, on machine tools, fixtures and dies for interchangeable work. Three years' shop experience. Box 17, AMERICAN MACHINIST.

FOREIGN

Man, 42 years of age, with 15 years' experience as works manager, and 6 years' foreign sales manager, desires position as latter at London, with A-1 American engineering firm. Thoroughly familiar with English and Continental business; up-to-date hustler. Box A. 3, AMERICAN MACHINIST, 6 Bouverie Street, London, E. C., England.

Help Wanted

Classification indicates present address of advertiser, nothing else.

ARKANSAS

Machinist for contract shop; one who can do all-around work; permanent position and steady work to right man. Address C. H. Ruggles, Hope, Ark.

ILLINOIS

Wanted—Operating clerk, middle aged, experienced factory man for manufacturing establishment. One who has mechanical experience, capable of issuing orders and following same to completion. Able to handle departments to company's best interest. Box 41, AMERICAN MACHINIST.

INDIANA

Wanted—4 toolmakers, 6 lathe men, 1 foreman. Good wages, steady employment. Box 943, AMERICAN MACHINIST.

MASSACHUSETTS

A manufacturing company wants a general foreman or division manager to develop a small tool department—taps, dies, reamers, drills, etc. Box 38, AMERICAN MACHINIST.

Wanted—By large manufacturing concern, high grade cost man who is thoroughly accurate, familiar with up-to-date systems and with iron and brass foundry melts, mixtures and reports. Man capable of taking charge. Address, giving experience and salary expected. Box 39, AM. MA.

MICHIGAN

Wanted—Machine-shop foreman with wide experience in modern shop practice to handle and direct 150 men. Plant located in Middle West — building heavy sawmill machinery. Man with technical education preferred. Box 40, AMERICAN MACHINIST.

NEW JERSEY

Toolmakers wanted for sub-press die and fine close fitting interchangeable parts. Box 46, AMERICAN MACHINIST.

Strictly first-class mechanical draftsman wanted; one with experience gained in large steelworks and who is able to design from preliminaries submitted. Give references and state nationality, age, training, etc. "Capable," care AMERICAN MACHINIST.

Salesman—A traveling salesman who is now selling the machine or railroad supply trade, to carry a high grade bearing metal (babbitt) as a side line, on liberal commission basis. Address, with full particulars, Lakewood Metal Co., Box 182, Lakewood, N. J.

Wanted—Man with technical education as mechanical engineer for sales department manufacturing company, vicinity New York. Must have had office experience and be a good correspondent. Give full details. Box 30, AMERICAN MACH.

NEW YORK

A first-class draftsman accustomed to tool and jig work. Must have had broad experience in this line. Send references with application. Good pay and steady place for the right man. Apply Box 27, AMER. MACHINIST.

Wanted—First-class designer for steam steering gears and general machinery. Must be a rapid and accurate draftsman and have some executive ability. In replying give detailed statement of experience, salary expected and references. Box 31, AMERICAN MACHINIST.

A competent salesman wanted to sell general, also special lines steel and iron from mills, in New York, New Jersey, Connecticut, western Massachusetts. No dead ones need apply. To receive attention state age, experience and salary expected. Box 34, AMER. MACH.

Wanted—Works manager, age between 30 and 35, college graduate; must be up-to-date, familiar with bonus system and structural and machine shop operations; also must be ambitious and energetic. The position has a promising future. Box 37, AMERICAN MACH.

Draftsman Wanted—Experienced detailer on punches, dies, roll and dial feeds, who will develop into a designer; permanent position, New York City, lower west side. State age, where and between what dates you did similar work, and salary received. "Confidential," Box 47, AMERICAN MACHINIST.

Is there a man in this country whose services can be promptly secured, competent from ability and actual experience to administer position of correspondent and office manager in business controlling special and general lines of steel and iron for direct sales as well as carrying stocks? To receive attention state age, experience and salary expected. Box 35, AMERICAN MACHINIST.

A young, growing manufacturing concern in Central New York is in need of a live, up-to-date machine shop foreman. Must be thoroughly capable, energetic, able to handle men to best advantage and to produce satisfactory results. Applicants should be not less than 30 years of age, not a "system crank," or "too big" for the place. Give references and detailed statement of experience, education, present position and lowest wages to begin with. Selection will be made upon information furnished. Box 42, AMER. MACH.

OHIO

Wanted—Assistant superintendent for machine shop employing 60 to 75 men. Must be competent to take full charge of the men and produce economical results. Best of references required. Box 15, AMERICAN MACHINIST.

General foreman for machine room employing about 100 men on automobile work in northern Ohio. Man must have had experience with piece work plan and must be capable of turning the work out quickly and cheaply. None but those holding down similar positions at the present time need apply. Box 989, AM. MA.

PENNSYLVANIA

Wanted—Hustling working foreman to handle machine department of 50 men. Machine work on machinists' tools. Shop located at Allentown, Pa. Box 36, AMERICAN MACHINIST.

For Sale

Valuable Canadian Patent—On labor-saving machine being rapidly introduced in the United States. Reynolds Machine Co., Moline, Ill.

For Sale—36"x48"x10' Cleveland open side planer, three heads. Like new. Original purchaser absolutely guarantees condition. Strong, Carlisle & Hammond Co., Cleveland, Ohio.

For Sale—Well equipped general machine shop in New Jersey, employing 24 hands and now running 13 hours per day and with good prospects for the future. Good reason for selling. Investigation solicited. Address "R," Box 1216, New York City.

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